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The Engineer

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Our Mineral Statistics.

PUBLIC NOTICES

TENDERS.

The Commissioners of HIS MAJESTY'S WORKS, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, the 28th November, 1923, for the SUPPLY of VALVES.

Forms of Tender, &c., may be obtained on application to the CONTROLLER of SUPPLIES, H.M. Office of Works, &c., King Charles-street, Westminster, London, S.W. 1. 4109

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

MILD STEEL PIPES, LAP-WELDED.

Tenders due on the 30th November, 1923.

Tender forms obtainable from above. 4139

Assistant Engineers (8) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, with prospect of permanency. Salary 400 dollars a month, rising to 800 dollars a month by annual increments of 25 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. Free passage provided. Candidates, age 25 to 35, preferably unmarried, must have received a good theoretical training, preferably at a University or Engineering College recognised by the Institution of Civil Engineers, or have completed articles with civil engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Possession of an engineering or science degree preferred. Must have had at least two years' practical experience in the design and execution of works of some considerable magnitude. A knowledge of modern roadmaking and maintenance is desirable.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting at top of application M/12,409. 4140

Engineer Required for the Architectural Office of the PUBLIC WORKS DEPARTMENT for the GOVERNMENT of HONG KONG for a period of three years, with possible permanency. Salary £460, rising by £360 a year by annual increments of £20, and thereafter if the appointment is made permanent by further annual increments of £20 to a maximum of £950 a year. The salary is converted into dollars at the Government rate of exchange, at present fixed at 2s. to the dollar; this rate is open to revision. Conveyance allowance of 240 dollars per annum is paid, and free passages provided. Candidates, unmarried, 25 to 30 years of age, must be architects' duly qualified assistants and should belong to the R.I.B.A. They should be conversant with all the usual routine of an architectural office, including the preparation of sketch designs and working drawings, specifications, quantities, measuring, &c., in connection with new buildings, additions and alterations. Should have had experience also in the design and execution of steel and reinforced concrete structures. Some experience is desirable in the maintenance of buildings. Municipal experience preferred.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, and quoting at head of application No. M/12,397. 4117

Belfast Union.

TO PROFESSIONAL CONSULTANT ENGINEERS.

PROPOSED CENTRAL HEATING AND LIGHTING SCHEME.

The Board of Guardians will, at their meeting to be held on Tuesday, the 18th day of December, 1923, receive from competent firms or persons qualified as above, SCHEMES for the INSTALLATION and EQUIPMENT of a CENTRALISED HEATING and LIGHTING PLANT.

The Guardians will subsequently decide which is the best Scheme submitted, and the person or firm submitting same will be paid the sum of One Hundred Guineas.

Information as to plan of buildings and general conditions respecting the appointment, and the proposal form may be obtained from the Clerk of the Union on deposit of the sum of Five Guineas, which will be returned after a bona fide proposal, with the necessary documents and particulars regarding such Scheme has been received.

Proposals, sealed and endorsed "Central Heating and Lighting Scheme," with full particulars, are to be lodged with me before Twelve o'clock Noon on above date.

Arrangements for inspection of the buildings, if desired, can be made on application to Mr. J. Mahood, Workhouse Master, on any day (Sundays excepted) between the hours of Ten o'clock a.m. and Twelve o'clock Noon, from whom further information can be obtained.

By Order,
R. H. WILSON,
Clerk of Union.

Clerk's Office, Union Workhouse,
Belfast, 13th November, 1923. 4143

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—

1. STEEL WORK for BRIDGES.
2. CAST IRON PIPES and VALVES.
3. FOUNDRY COKE.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Steel Work for Bridges," as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 7th December, 1923, in respect of Specifications Nos. 1 and 2, and not later than Twelve Noon on Friday, the 23rd November, 1923, in respect of Specification No. 3.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for a copy of each specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster.

A. MUIRHEAD,
Managing Director.

8th November, 1923.
91, Petty France, S.W. 1. 4100

PUBLIC NOTICES

Administrative County of LONDON.

LEWISHAM BRANCH SEWER.

The London County Council invites TENDERS for the CONSTRUCTION of a BRICK SEWER of varying sizes, from 5ft. to 9ft. internal diameter, of a total length of about 3 miles, with WEIR CHAMBERS, TUMBLING BAYS, DROP SHAFTS, SIDE ENTRANCES and CONNECTIONS to existing Sewers, &c., in the Metropolitan Borough of Lewisham.

Persons desiring to submit Tenders may obtain on and after Friday, 16th November, 1923, the form of Tender, &c., on application to the Chief Engineer, at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £10. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after Twelve Noon on Tuesday, 11th December, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
4118 Clerk of the London County Council.

Administrative County of LONDON.

STREATHAM HILL SEWER.

The London County Council invites TENDERS for the CONSTRUCTION of a 4ft. internal diameter SEWER in BRICK of a total length of about 7200ft., including MANHOLES, SIDE ENTRANCES, VENTILATORS, TUMBLING BAYS, and WEIR CHAMBER, and ALTERATIONS and CONNECTIONS to existing BRICK and PIPE SEWERS in the Metropolitan Boroughs of Wandsworth and Lambeth.

Persons desiring to submit Tenders may obtain on and after Friday, 16th November, 1923, the form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £5. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after Twelve Noon on Tuesday, 11th December, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
4119 Clerk of the London County Council.

Administrative County of LONDON.

The London County Council invites TENDERS for a 10-Ton Hand-operated OVERHEAD TRAVELLER of 34ft. 6in. span, for the Isle of Dogs Pumping Station, London, E.

Persons desiring to submit Tenders may obtain the drawing, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, Charing Cross, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawing, specification, and other contract documents may be inspected at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 3rd December, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
4120 Clerk of the London County Council.

PUBLIC NOTICES

Great Southern and Western RAILWAY (IRELAND).

CONTRACTS, 1924.

The Directors of the Great Southern and Western Railway Company are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES for three months, commencing 1st January, 1924, and alternatively for six months, commencing the same date :—

	No. of Form.
Acid, Sulphuric	3D
Asbestos Sheeting, &c.	40
Baskets	10
Bolts, Nuts, and Rivets	15
Brooms and Brushes	13
Brass Fittings for Carriages	14
Do. Do. for Water	26A
Do. Do. for Gas	26B
Canvas and Sacks	6
Canvas for Wagon Tarpaulins	6A
Castings, Mall. Iron	11
Carriage Lace	7A
Cloth for Carriages	7C
Clothing, I.R. proofed	9B
Coach Screws and Washers	15
Colours	2
Corks	39
Cotton Waste	5A
Crucibles	41
Drysalteries	3
Emery and Glass Cloth, &c.	28
Files and Tool Steel	20
Fire Bricks and Clay	33
Foundry Requisites	42
Galvanised Sheets, Buckets, &c.	23
Grates, Stoves	24
Grindstones	28
Glass, Sheet, and Plate	27A
Glass and China Sundries	27B
Hardware (Sundry)	17
India Rubber Goods	9A
Implements, Sundry	21
Iron Tubes and Fittings	29
Leather and Leather Goods	12
Locks and Keys	19
Mats, Fibre	10
Nails	31
Packings	40
Plumbago	41
Rain Water Pipes and Gutters	25
Ropes, Twine, and Flax	4
Soaps	8C
Sewer Pipes, Plaster of Paris, &c.	32
Shovels, Spades, &c.	21A
Sponge Cloths	5
Signal Wire Pulleys	11
Screws and Split Pins	14
Tin Plates	22
Waste	5A
Waterproof Clothing	9B
Wicks	5
Wire, Fence, and Signal	30A
Wirework	30B

Forms of Tender can be obtained on payment of 6d. each from the Stores Superintendent, General Stores Department, G.S., and W.R., Inchicore, Dublin. Applications for forms by post must be accompanied by postal order. Stamps cannot be accepted. All inquiries for information should be also directed to the Stores Superintendent.

Patterns may be inspected at the General Stores Department on and after the 16th inst., between the hours of 10 a.m. and 4 p.m. (except on Saturdays).

Tenders must be enclosed in the special envelope supplied for the purpose with each Schedule, and must be posted so as to be with the undersigned before 10 a.m. on Wednesday, 28th November, 1923.

The Directors will not consider any Tender unless it is furnished on the Company's form, and do not bind themselves to accept the lowest or any Tender.

By Order,
C. E. RILEY,
Secretary.

Kingsbridge Terminus, Dublin,
November, 1923. 4103

Ince-in-Makerfield Urban District Council.

The Urban District Council of Ince-in-Makerfield invite TENDERS for :—

DIESEL OIL ENGINE DRIVING BORE-HOLE and HORIZONTAL PUMPING SETS, in DUPLICATE.

Specification and particulars of Tender may be had from the undersigned on payment of a sum of £2 2s., which will be returned on a bona fide Tender being received.

Sealed Tenders, endorsed "Tender for Waterworks Plant," must reach the undersigned not later than 10 a.m., November 30th, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

A. F. HOWGATE,
Clerk.

Council Offices,
Ince, near Wigan. 4125

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :
(1) WROUGHT IRON, &c., FITTINGS for CARRIAGES.
(2) GUN-METAL LAVATORY and other FITTINGS for CARRIAGES.
(3) INDIA-RUBBER, &c., FITTINGS for CARRIAGES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C., on or after 12th November, 1923.

A fee of £1 1s. will be charged for each specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Monday, 26th November, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. C. VOLKERS,
4092 Secretary.

City of Liverpool.

TRAMWAY MATERIAL.

The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of various classes of TRAMWAY MATERIAL as under.

Firms are required to state clearly when making application for the necessary Tender forms the name and number of the schedule for which they desire to be furnished with Tender form.

Duplicate forms of Tender for record purposes will NOT be supplied.

SCHEDULE No. 1.—STEEL TRAMWAY RAILS and FISH-PLATES.
" No. 2.—STEEL FISH-BOLTS.
" No. 3.—STEEL TIE BARS.
" No. 4.—COPPER BONDS.
" No. 5.—TIMBER SLEEPERS.
" No. 6.—STEEL SPIKES.

Tender forms will be forwarded UPON RECEIPT OF APPLICATION IN WRITING to
The City Engineer,
Municipal Buildings, Dale-street,
Liverpool.

LATEST DATE FOR RECEIPT OF TENDERS TEN O'CLOCK A.M. on FRIDAY, the 23rd INSTANT.

WALTER MOON,
Town Clerk.
7th November 1923. 4087

Parish of Lambeth.—Board of GUARDIANS.

LAUNDRY PLANT.

The Guardians of the Poor of the Parish of Lambeth are prepared to receive TENDERS for the PROVISION and INSTALLATION of LAUNDRY PLANT at their Norwood School.

Forms of Tender and specification may be obtained upon application to the undersigned.

The Guardians do not pledge themselves to accept the lowest or any Tender.

By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.

Guardians' Offices,
Brook-street, Kennington, S.E. 11. 4115

Parish of Lambeth.—Board of GUARDIANS.

The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for the PROVISION and INSTALLATION of ELECTRIC LIGHT WIRING and FITTINGS at the Lambeth Hospital, Brook-street, Kennington, S.E.

Printed forms of Tender (which alone will be received) with conditions annexed, together with specification, may be obtained at this office on any day (except Saturday) between the hours of Ten and Five, upon payment of £2 in respect thereof, which will be returned to each person sending in a bona fide Tender. The drawings may be inspected at this office and copies thereof may be obtained upon payment of the sum of 3s.

The Tenders, which must be sealed and superscribed in accordance with the instructions set forth on the form of Tender, must be sent to the undersigned or placed in the box provided for their reception in the office of the Clerk to the Guardians by the tenderers or their representatives, should they so desire, on or before Tuesday, the 27th inst., and will be opened in the Board Room at Twelve Noon on the following day, when all persons tendering or their authorised agents should be in attendance.

The Guardians do not pledge themselves to accept the lowest or any Tender.

By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.

Guardians' Board Room and Offices,
Brook-street, Kennington-road, S.E. 11,
19th November, 1923. 4114

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For Advertisement Rates see Page 533, Col. 1.

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PUBLIC NOTICES

Great Northern Railway (Ireland).

TENDERS FOR WAGONS.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

200 STANDARD 10-TON OPEN WAGONS, and

FIVE 25-TON GOODS BRAKE VANS,

in accordance with the drawings and specifications, copies of which may be obtained on application to the undersigned upon payment of £1, which will be refunded on receipt of a bona fide Tender and on return of the drawings and specifications.

Tenders, made out on the forms supplied by the Company, should be delivered, under sealed cover, endorsed "Tender for Wagons," not later than 10 a.m. on December 10th.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS,
Secretary.

Amiens-street Station, Dublin.
13th November, 1923. 4156

Macclesfield Corporation.

TRENTABANK WATER SCHEME.

CONTRACT NO. 1.—CAST IRON PIPES.

The Macclesfield Corporation are prepared to receive TENDERS from experienced Pipe Founders for the SUPPLY and DELIVERY of about 1180 TONS of CAST IRON PIPES and SPECIALS of 18in., 15in., 12in., 6in., and 3in. diameters, manufactured in accordance with the British Standard Specification.

The specification and form of Tender, prepared by Dr. H. Lapworth, M. Inst. C.E., 13, Victoria-street, Westminster, S.W. 1., Engineer, may be obtained from the undersigned upon payment of a deposit of £2. The amount of the deposit will be returned only after the receipt of a bona fide Tender by the date specified and the return of the specification.

Sealed Tenders, marked "Contract No. 1. Tender for Cast Iron Pipes," and addressed to the undersigned, must be delivered not later than 10 a.m. on the 28th day of November, 1923.

The Corporation do not bind themselves to accept the lowest or any Tender.

F. E. OLDFIELD,
Town Clerk.

41, Churchside, Macclesfield.
9th November, 1923. 4102

St. Pancras Borough Council,

Electricity Department, invite TENDERS for the SUPPLY of ONE VERTICAL ELECTRIC MOTOR-DRIVEN CONDENSING WATER PUMP, capable of dealing with 750,000 gallons per hour. Specification may be obtained and drawings seen at the offices, 57, Pratt-street, Camden Town, on payment of One Pound, which will be returned on receipt of a bona fide Tender.

Tenders to be sent in on or before Noon on December 6th, 1923.

The Borough Council do not bind themselves to accept the lowest or any Tender.

C. H. F. BARRETT,
Town Clerk.

Town Hall,
Pancras-road, N.W. 1. 4109

The Metropolitan Asylums

BOARD invite TENDERS for the REMOVAL of the OLD BOILER and SUPPLYING and FITTING a NEW BOILER to the RIVER AMBULANCE STEAMER "MALTESE CROSS," in accordance with specification prepared by Mr. Thomas Cooper, M.I.C.E., M.I.M.E., Engineer-in-Chief to the Board.

Specification, conditions of contract and form of Tender may be obtained at the office of the Board, Victoria Embankment, London, E.C. 4.

Tenders, addressed as noted on the form, must be delivered at the office of the Board not later than 10 a.m. on Tuesday, 4th December, 1923.

G. A. POWELL,
Clerk to the Board.

4098

PUBLIC NOTICES

Tenders are Invited for the

PURCHASE of SECOND-HAND PUMPING MACHINERY for disposal at No. 6 Pumping Station, Southampton Docks.

TWO "Invincible" CENTRIFUGAL DRY DOCK PUMPS, each driven by a Twin High-pressure Cylinders STEAM ENGINE; cylinders 28in. bore, 18in. stroke; approx. H.P. 1000 at 140 revs. and 150 lb. steam pressure; average pump capacity 400 tons per minute at gauge head 0-40ft.

ONE 45in. "Invincible" CENTRIFUGAL DRY DOCK PUMP, driven by a Compound STEAM ENGINE; cylinders 16in. by 30in. bore, 18in. stroke; approx. H.H.P. 850 at 150 revs. and 150 lb. steam pressure; average pump capacity 200 tons per minute at gauge head 0-15ft.

ONE 9in. "Invincible" CENTRIFUGAL CIRCULATING WATER PUMP, driven by a Single-cylinder STEAM ENGINE, steam pressure 150 lb.

TWO Compound Steam-driven "Edwards" AIR PUMPS; pump chamber 18in. by 10in., revolutions 400 per minute.

ONE CYLINDRICAL SURFACE CONDENSER, 13ft. by 5ft. by 3in.

ONE CYLINDRICAL SURFACE CONDENSER, 14ft. 3in. by 5ft. 6in.

ONE Wrought Steel STEAM RANGE for 100 lb. working pressure, recently installed, comprising :—

36 Feet of 9in. Straight.
18 Feet of 9in. straight with 6in. Branch.
One 9in. Bend, 6ft. 9in. by 12ft.
One 9in. Bend, 16ft. 4in. by 3ft.
One 9in. Bend, 8ft. by 8ft. 9in.
One 9in. by 8in. by 8in. Steam Separator.

Small Quantity of 6in. PIPE and Sundry VALVES, COCKS, STEAM TRAPS, SUPPORTS, &c.

A Quantity of CAST IRON FLANGED PIPING as follows :—

Approx. 26 Feet of 20in.
Approx. 65 Feet of 14in.
Approx. 170 Feet of 9in.
Approx. 60 Feet of 6in.
Approx. 85 Feet of 4in.
Approx. 60 Feet of 3in.

A Quantity of CAST IRON GATE VALVES as follows :—

One 26in.
Four 14in.
Twelve 9in.
Two 6in.

Sundry Smaller VALVES and FITTINGS.

Full particulars can be obtained from C. FRANCIS, Esq., Stores Superintendent, Southern Railway, Waterloo Stations, S.E. 1. 4130

The Assam-Bengal Railway

COMPANY, Limited, is prepared to receive TENDERS for :—

STEEL TYRES for CARRIAGES and WAGONS.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges, Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Monday, the 3rd December, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
OSWALD I. MILNE,
Secretary.

9th November, 1923. 4093

SITUATIONS OPEN

WANTED, a First-class MAN, Versed in Up-to-date Methods, to Promote Sales and Conduct breezy Advertising Campaign for a high-class Firm of Boiler Manufacturers. Must be familiar with form-letter method of advertising. Reply briefly, stating age, health, whether married or single, and past experience, if any. Salary £400 and commission to the right man.—Address, 4101, The Engineer Office. 4101 A

PUBLIC NOTICES

Poole Corporation Waterworks.

CONTRACT NO. 8.
CAST IRON PIPING.

The Corporation of Poole invite TENDERS for the SUPPLY and DELIVERY at Broadstone Junction Station, of about 2800 LIN. YARDS of 18in., 16in., and 9in. CAST IRON PIPES and SPECIALS in accordance with the specification prepared by the Engineer, Mr. A. P. I. Cotterell, M. Inst. C.E., of 17, Old Queen-street, Westminster, S.W. 1.

Specifications may be seen during the usual office hours at the office of the Engineer, and copies of bill of quantities and form of Tender obtained by intending contractors on payment of the sum of Five Guineas, which will be returned on receipt of a bona fide Tender and all other documents supplied.

Tenders, marked "Cast Iron Pipes, Contract No. 8," on the form supplied, are to be delivered to me not later than 10 a.m. on Friday, the 30th November, at my office below mentioned.

The Corporation do not undertake to accept the lowest or any Tender.

CHARLES LISBY,
Town Clerk.

Municipal Buildings,
Poole, Dorset. 4140

SITUATIONS OPEN (continued)

WANTED, QUARRY MANAGER, for Large Road Stone Quarries in the West Midlands. Commencing salary £500 to £600 per annum. With thorough knowledge of Crushing and Tar-macadam Plants and General Mechanical and Engineering ability.—Address, stating experience, with copies of three recent testimonials, P8317, The Engineer Office. P8317 A

ASSISTANT ELECTRICAL ENGINEER REQUIRED for Iron and Steel Works Department. Must have had experience in High-tension Work and preferably in Electrical Equipment of Modern Rolling Mills and Blast-furnaces.—Full particulars of technical and practical experience, also salary required, to be sent to the SECRETARY, Consett Iron Co., Ltd., Consett. 4009 A

ASSISTANT TANK FARM SUPERINTENDENT REQUIRED for the East, with experience in Tank Erection and in the Construction of Large Tank Farms. Must be of good organising ability, able to control European staff (erectors) and native labour, and carry out work economically. Salary according to qualifications. Three years' agreement and free passage out and home. Free furnished bachelor quarters, but not messing.

Age not over 35.

Write, with full particulars and copies of testimonials, to Box A, c/o The Regent Advertising Service, Ltd., 4, London Wall-buildings, London, E.C. 2. P8308 A

CHIEF ESTIMATOR and RATE FIXER REQUIRED for Machine Tool Works working on straight piecework system. Only those who have thoroughly up-to-date knowledge of Machine Tool Manufacture need apply.—Apply, in own handwriting, giving age, salary expected, and at least two references, to ALFRED HERBERT, Ltd., Edgwick Works, Coventry. 4005 A

POWER STATION SUPERINTENDENT REQUIRED. Salary £400 per annum to commence. Only engineers who have had previous experience in the operation and overhaul of Steam Turbines, Water-tube Boilers, E.H.T. 3-Phase Plant, Switchgear, &c., and control of men need apply.—Applications, giving full particulars of training and experience and age, accompanied by copies of recent testimonials and stating earliest date when duties could be commenced, to be sent to 4142, The Engineer Office. 4142 A

12th November, 1923.

REQUIRED IMMEDIATELY for Continent, Experienced RAILWAY OFFICIAL or ENGINEER for temporary employment. Knowledge of French essential. Salary £750 per annum with furnished married quarters and all travelling expenses.—Address, 4127, The Engineer Office. 4127 A

SITUATIONS OPEN (continued)

REQUIRED, SALES MANAGER

FOR ENGINEERING SPECIALITIES.

Conditions : (1) Capable of controlling outside and inside staff.
(2) Knowledge of home and foreign markets.
(3) Proof of at least three years' successful work with engineering concern in England.

Desirable : Knowledge of French and Spanish and good appearance.

Please address with fullest details to 4123, The Engineer Office. 4123 A

SALES ENGINEER WANTED by City Office of American Firm. Must be a man of about 30, with a public school education (or holding engineering degree), with a few years' experience in selling machinery in London. Preference will be given to a man of attractive and forceful personality, who will be paid a salary in accordance with his qualifications.—Address, stating age, salary required, and previous experience, 4140, The Engineer Office. 4140 A

WANTED, DRAUGHTSMAN, Used to Cast Iron Pipe Work. State age, experience, and salary required.—Address, 4135, The Engineer Office. 4135 A

CHIEF DESIGNER WANTED for Important Firm manufacturing Crude Oil Engines, two-stroke and four-stroke cycle. Applicants must have held similar position.—Address, stating age, experience, and salary required, 4134, The Engineer Office. 4134 A

DRAUGHTSMAN, MECHANICAL, REQUIRED in an Electrical Engineer's Office, West of London. Must be sound in mechanical details. State experience, age, and salary required.—Address, 4131, The Engineer Office. 4131 A

DRAUGHTSMEN. — SEVERAL FIRST-CLASS DRAUGHTSMEN REQUIRED for Aeroplane Design. Must be capable section leaders with previous experience of carrying out complete design of components. State full particulars of experience, age, and salary required, to THE H. C. HAWKER ENGINEERING COMPANY, Ltd., Kingston-on-Thames. 4136 A

DRAUGHTSMAN, with Sound Theoretical and Technical knowledge of Electric and Steam Cranes and their kindred structural work. To a man who can supplement sound engineering experience by developing a commercial bent there are good prospects of advancement. State experience fully, age, salary required.—Address, 4150, The Engineer Office. 4150 A

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A Seven-Day Journal

Aerial Defence.

SPEAKING at the Lord Mayor's banquet at Guildhall on Friday evening of last week, Sir Samuel Hoare, Secretary of State for Air, dealing with the problem of defence against aerial attack, made the highly significant statement that the reduction of our Air Force to one-tenth of its great war-time value had been carried out in such a way as to make speedy expansion almost impossible. When he assumed office, twelve months or so ago, there was, he said, practically no air force at all within our shores ready and trained for home defence. The position was, however, being improved from month to month, and when the first stage of the Government's scheme was completed, we would have 52 home defence squadrons comprising about six hundred first line machines. Dealing with airships, he declared his belief not only in their commercial but in their strategic value, and added that he could see no reason why the first steps should not be taken for starting a great Imperial air route between Great Britain and the Far East.

The Weight and Speed of Ships.

WHAT has been described as "a remarkable navigation announcement" has been received from Washington and published this week in the British Press. Taken at its face value, the statement makes it appear that the United States Navy—or Navy Institute, it is not clear which—has discovered that a ship travelling eastwards is lighter than when travelling westwards as a result of the rotation of the earth. As a specific example, it is stated that a 1100-ton destroyer, travelling westward at 25 knots, "would add 262.8 lb. to her weight with corresponding increase in displacement and draught; while the same speed eastward would subtract 480.628 lb. from her weight, with consequent decreased displacement and draught." There is, of course, no novelty in this "discovery." Since a vessel travelling at 25 knots has a speed of 42ft. per second, and since the peripheral speed of the earth at the equator is 1560ft. per second, it is clear that when steaming westward, with the two speeds opposing each other, the true lineal velocity of the ship is 1518ft. per second, while on an eastward course it is 1602ft. The centrifugal force on a vessel of the size and speed named is, thus, 8410 lb. on a westward course, and 9366 lb. on an eastward, indicating a difference of 956 lb. between the two conditions. The sum of the figures quoted in the announcement is 743 lb. The discrepancy between these two figures is easily accounted for. We are not told what latitude the American value relates to, but a simple calculation indicates that it is based not on the velocity of the earth at the equator, but on a peripheral speed of 1213ft. per second. This is the surface speed of the earth in latitude 39 deg.; that is to say, approximately the latitude of the Brooklyn Navy Yard—more precisely the latitude of Baltimore.

Yarrow's Restarting.

WE are glad to learn that after many months of enforced idleness there is some prospect of work being resumed in the engine shops and shipyard at Scotstoun of Yarrow and Co. (1922), Limited. The firm has just secured an order for a large shallow draft river steamer from the Anglo-Saxon Petroleum Company. This vessel will follow very closely the design of the large number of river gunboats which Yarrow's built during the war. It is intended for service on the Yangtze-Kiang River between Ichang and Chungking, a stretch of which the navigation is made difficult and dangerous by virtue of the many whirlpools and rapids encountered in it. The vessel will carry oil fuel in bulk, and will be propelled by two sets of triple-expansion engines, developing a total of 3000 horse-power, steam being supplied by two Yarrow boilers arranged for oil burning.

Home Grown Sugar.

THE success which has attended the operations this year of the Kelham and Cantley sugar factories has aroused much interest elsewhere in the country, and proposals for the erection of other similar establishments in different districts are now under consideration. Among the suggested sites for additional factories are Kidderminster and Gloucester. In connection with the proposed establishment at the second named place, Mr. J. M. Scott last Saturday addressed the local branch of the National Farmers' Union on the subject of Sugar-beet Cultivation. In the course of his remarks, he suggested that the old munitions factory at Quedgeley would provide a very suitable works for the undertaking. Half the capital required, it was proposed, should be subscribed locally and the other half be found by the Sugar-Beet Growers' Association. If a hundred such factories were established in this country, he continued, we would still only be able to produce at home just a quarter of our sugar requirements, but work would be found for 600,000 men, or about half the total number at present out of employment. The Gloucestershire farmers received the suggestion for the development of the sugar-beet industry with a considerable amount of caution and reserve, one representative going so far as to say that sugar-beet growing was not as profitable as the cultivation of mangolds. Mr. Scott, on the other hand, recorded that he had grown 17 tons of sugar beet to the acre, and received £3 10s. per ton for the crop.

The Control of Wealth.

THE name of Professor Soddy is perhaps more intimately associated with the science of physical chemistry and radio activity than with socialism; but in the course of a lecture which he delivered in Glasgow last Friday before the Union of Democratic Control and the Socialist Teachers' Society, he showed himself as what may perhaps best be described as an ardent scientific socialist. He sought to demonstrate that under a humane Government science would play the part of a great emancipator and peacemaker. With abundant food, clothing and fuel as the material blessings of science, he held that poverty to-day was not due to shortage but to unemployment following over-production. The control of wealth, he contended, was in the hands of the captains of finance, upon whom our inverted system conferred the power of inflation and deflation of the currency which, in their effects were indistinguishable from the private coining and withdrawal of money. He also spoke at some length on banking systems and their power for good and evil. Scotland, he said, was naturally a poor country, but in the past had been able to maintain a hardy and distinguished race. No little of its past greatness had been produced by its unusually intelligent banking system, but its modern system required attention or it would be too late to retain the nation's moral and mental superiority except only as a memory.

A Wireless Transmission Experiment.

INFORMATION received this week from America records a very interesting wireless transmission experiment recently made by Dr. Alexanderson, chief engineer to the Radio Corporation of New York. From the Corporation's Broad-street office a signal was sent through the Long Island station direct to Poland, where it was made to actuate the Warsaw transmitter and return to New York. On its return it was again reflected to Warsaw, and so on, back and forth, each time with diminishing intensity, until after forty double journeys it became inaudible. Each double journey represented a distance of nearly 9000 miles, so that all told the signal—if it be permissible to regard it as one and not a series of signals—travereed a total distance of something not far short of 360,000 miles, or approximately fourteen times round the earth at the equator. Since wireless waves travel with the speed of light—186,000 miles a second—the total time occupied in the forty traverses was, approximately, two seconds.

The U.S. Merchant Fleet.

THERE would appear to be no truth in the rumours that have been in circulation regarding the sale of the Leviathan, or any of the other passenger vessels now being operated by the United States Shipping Board, or regarding the formation of a German-American combine, so far, at least, as the Shipping Board is concerned. Mr. Edward P. Farley, Chairman of the Board, is now on a short visit to this country, but has declared that his object in coming across is to study the continental service provided by the vessels operated by the Board and the United States Line. The Board, he added, owned about 1300 ships, having a total deadweight of some 10,000,000 tons, and of these vessels 365 were now in actual service and were getting their fair share of goods and passengers on all routes. The United States, he explained, were determined to maintain sufficient tonnage to obviate another shortage such as occurred during the war.

Material for Gas Holders.

AMONG several interesting questions discussed at the meeting of the Society of British Gas Industries, held in London on November 8th, was that raised by Mr. R. J. Milbourne, namely, the need of research work in connection with the material used for gasholder construction. At the beginning of the present century, he said, mild steel sheets began to be employed for gasholder work, but it was common knowledge that many holders constructed of that material had to be repaired or entirely re-sheeted. On the other hand, there was quite a number of gasholders erected from fifty to seventy years ago, in the construction of which wrought iron had been employed, which were as sound to-day as when they were erected. It appeared from experience that whereas the average life of a gasholder constructed of mild steel sheets was not more than twenty to twenty-five years, holders constructed of sheets of Staffordshire iron might have a life of eighty to one hundred years. The trouble with mild steel was its liability to corrosion inside the gasholder. It had been suggested that this internal corrosion might be due to the composition of the gas, and this view was strengthened by the fact that similar trouble had been experienced with gas meters. Having regard to the importance of the subject, he suggested that a committee of investigation, consisting of members of the Society and of the Institution of Gas Engineers should be appointed to organise a research into the causes of the deterioration of mild steel gasholder sheeting.

The Boilermakers' Dispute.

LAST Friday, as a result of the efforts of the Trades Union Congress Mediation Committee, a conference opened in London between the Shipbuilding Employers' Federation and the Boilermakers' Society with a view to the settlement of the overtime, night-shift and holiday work dispute. The Federation of Engineering and Shipbuilding Trades, a body of which the Boilermakers' Society was at one time a member, agreed to stand aside from the conference, although it was vitally concerned in its outcome. The Boilermakers' Society was represented not only by its executive, but by about fifty district delegates. After joint and separate meetings of the two parties, the conference was adjourned until the following day; but late on Saturday evening it was made clear that still no settlement had been reached, and that it had been found necessary to adjourn the conference until Wednesday of this week at Edinburgh. Great disappointment was naturally expressed at the failure to reach a settlement of the dispute, and what consolation was possible had to be drawn from the fact that the conference had been adjourned and not broken off. It seems that the boilermakers still persisted in their claims for special treatment, but that the employers considered themselves bound by the agreement entered into with the Federation of Shipbuilding and Engineering Trades and, therefore, to be unable to do more than repeat the promise made at the Carlisle conference to the effect that consideration would be given to any special circumstances which might arise in connection with any particular trade. The conference is still continuing.

Railway Signalling Colours.

ONLY three colours—red, green and yellow—are used in railway signalling; white is not employed at all for running signals except as a "danger" indication in connection with certain ground discs. When the importance of the message the colours convey to drivers is recognised, the vital necessity for efficiency therein is manifest. Yet it must be acknowledged that the subject did not, until quite recently, when long-burning lamps and yellow glass were introduced, receive anything but scant attention. No effort, even now, is made to obtain the correct shades for accuracy of colour and for the longest possible vision. The reason for this fact has been that whilst the signal engineer has appreciated that these necessities could be obtained by scientific methods, he has, because of the cost, hesitated to urge that this correct standard should be achieved. The paper on "Signalling Colours," read at the Institution of Railway Signal Engineers, has, we trust, provided the desired opening for the need and the remedy to be pointed out. Messrs. R. F. Lanksheer and A. F. Bound, the joint authors, pleaded that the companies should consider the desirability of setting up a small laboratory wherein tests might be made, standards arrived at, and measurements made with glasses to see that their value corresponded with the standard.

Railway Labour.

THE National Wages Board resumed on Tuesday the hearing of the demands of the railway companies for modifications in the National Agreement made in March, 1919. Mr. W. Clower is the principal witness for the railways, and his case mainly is that the men are better paid than those in kindred industries. Traders, he said, had pointed out, "and with justice," that whilst the wages of their workers had been brought down to a commercial level, the wages of the railwaymen were maintained at an abnormally high standard. The latter were from 100 to 144 per cent. above the pre-war level, as against from 18 to 100 per cent.—the last named in one instance only—in other industries. The companies anticipated that the modifications now asked for would result in a saving of £4,000,000 a year. Were it a question of bringing the railwaymen's wages down to the level of those in other industries, a reduction to 70 per cent. above the pre-war level would have to be made. The saving then would be £37,000,000 a year. The companies may have to come to the Board later with such an application. One of the illustrations used by Mr. Clower to show the evils of the National Agreement related to the wages of the men on shunting engines. The pay of these men was the same as for train enginemen. It was proposed to re-classify the enginemen and to give a lower rate to shunting enginemen and to motormen. Platelayers, again, were paid double time when working on Sundays, but in all other grades the men were paid time and a-half.

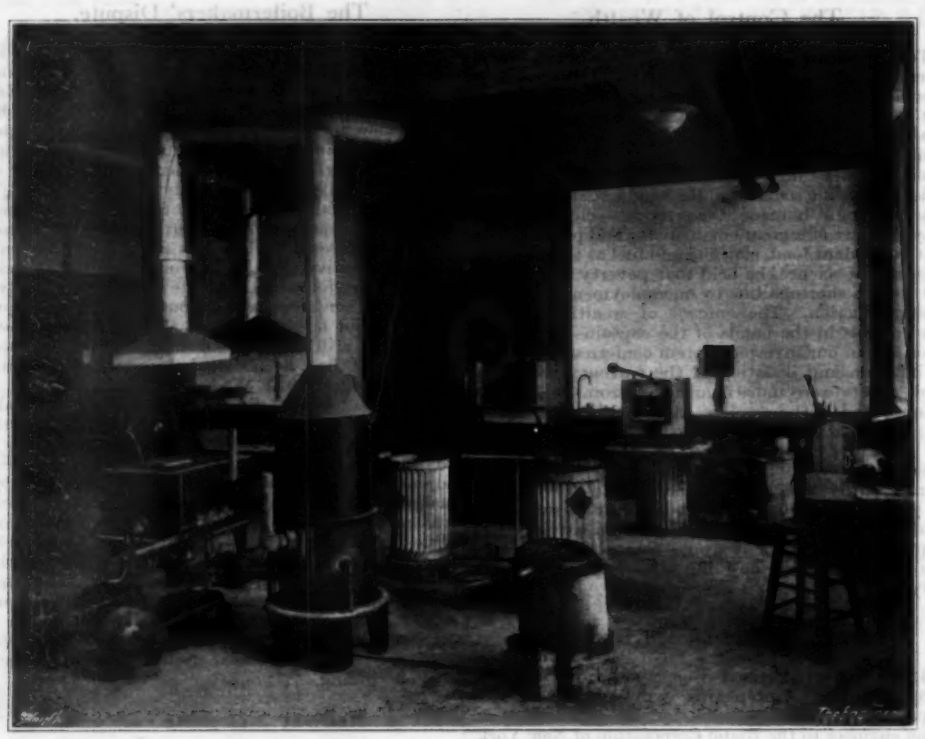
Science and Industry in America.

By WALTER ROSENHAIN, D.Sc., F.R.S.

No. X.*

CONCLUSION.

TURNING to other departments of the Bureau of Standards, we find that a good deal of space and equipment has been devoted to metallurgy. The division is equipped with an excellent range of microscopes and pyrometric appliances, some of which



EXPERIMENTAL FOUNDRY AT THE UNITED STATES BUREAU OF STANDARDS

are more or less replicas of those in use at the National Physical Laboratory in England. In the basement of the building is an experimental foundry, a heat treatment room and a rolling mill, which are shown in the accompanying illustrations. The rolling mill is remarkable for the absence of all fly-wheels, an arrangement which requires the installation of a much more powerful motor than would otherwise be necessary in order to overcome the initial resistance when a piece of metal enters the rolls. It was, however, thought that for experimental purposes the mill would be more readily controllable in the absence of a fly-wheel. In actual practice at the experimental mill at the National Physical Laboratory, however, the presence of an 8-ton fly-wheel has not made itself felt in any undesirable manner. With regard to the work carried out in the Metallurgy Division of the Bureau of Standards, while it covers a very wide field, it appears to be mainly directed to the solution of problems and difficulties which have presented themselves to American metallurgical industry. In addition to dealing with these practical problems, a large amount of time and energy is devoted to the compilation of reports or "circulars" summarising existing knowledge on various metals and alloys. These constitute extremely valuable works of reference, although in many cases one could wish that the treatment of the subject might be more critical and not so purely bibliographical, as it tends to become. Of more fundamental research, dealing with the larger problems of metallurgy, there is not so much evidence. Dr. Burgess, formerly head of the Metallurgy Division, and recently appointed Director of the Bureau of Standards in succession to Dr. W. S. Stratton, fully recognises the need for fundamental research, and the fact that a national laboratory having at its command a unique equipment is particularly well fitted to undertake work of this kind. Circumstances, however, have not favoured this development at the Bureau of Standards. Contact with the American Congress and political forces generally serves to bring about a tendency to restrict the activities of the Bureau to an undue extent to matters of immediate practical importance. On the other hand, the bureau suffers from a difficulty in retaining the more valuable members of its staff, owing to the fact that the rate of pay of scientific workers in the bureau is exceedingly low as compared with the salaries which are offered by industry outside. The consequence has been a very rapid turnover of members of the staff, and the loss, one after another of some of the most promising investigators whose work was making itself felt at the Bureau. It is hoped that with the advent of more normal conditions this state of affairs will be remedied, but it is obvious that a real solution cannot be found until the scales of pay at the Bureau of Standards have been brought more nearly into line with those offered for corresponding work outside.

* No. IX. appeared November 9th.

THE CHEMICAL DIVISION.

The Chemical Division of the Bureau of Standards, working under the direction of Dr. Hillebrand, presents many points of special interest. The building itself is particularly well designed and arranged, especially in regard to the disposal of pipes and conduits which generally form a cumbersome feature in large chemical laboratories. In this building they are all placed in a hollow space between two parallel walls, really constituting a thick hollow wall separating the main corridors from the rooms. The result of this arrangement is that the doors appear to be arranged in embrasures nearly 4ft. deep, but this space serves to house not only wardrobe cupboards for the staff of each room, but also fume cupboards and all gas, water, vacuum and exhaust pipes required for the service of the building. Provision is also made for the supply of fresh air to each room by a positive ventilating system to which, if necessary, moistening appliances can be attached. The work done in this building covers a wide range, mainly on inorganic and physical chemistry. One important function which is carried out here is the preparation and issue of standardised samples. It has been recognised that any attempt to standardise methods of analysis could not be perfectly successful, mainly because developments and improvements in analytical methods are frequent and different methods are suitable to the appliances and personal skill of individual operators. In order, however, to bring about uniformity of results, which is essential for commercial purposes, the device has been adopted of issuing standardised samples by which each individual analyst can, if he desires, test the accuracy of his methods. The preparation of such standardised samples is, of course, a matter requiring the greatest care and one which can only be properly undertaken in a National Institution in whose results the fullest confidence can be reposed by all concerned. The Bureau of Standards does not undertake the whole of the work in connection with such standardisation, but secures the co-operation of the leading analysts of America and publishes their results as well as its own in connection with the standards when issued. The materials standardised include, in the first place, metals and alloys, but the system has now been extended to embrace a certain number of standard chemicals used in analytical and other processes, and it is proposed to extend it still further to other materials. It will be remembered that a somewhat similar undertaking has recently been begun, in conjunction with the Iron and Steel Institute by the British National Physical Laboratory, but for the present this has been confined to the issue of standardised samples of steel, although the standardisation of samples of other metals, notably of aluminium, is being considered. The methods adopted in England differ somewhat from those which have been employed in America, but a full interchange of views and experiences on this matter between the National Physical Laboratory and the Bureau of Standards has taken place, as a result of which a mutual levelling-up of methods is likely to occur. Thus, in regard to steel, the Bureau of Standards' samples are standardised for all the various constituents, while the quantities prepared at one time by the Bureau are comparatively small. In England a different practice has been adopted, large samples being prepared at one time, each being standardised for one constituent only. In this way it is hoped to minimise the necessity for re-standardisation of samples at frequent intervals, the rate at which a given sample will be exhausted being much smaller when it is used for testing in connection with one constituent only. This system, together with the use of larger quantities of steel at one time, justifies a considerably greater expenditure of time and care upon each individual standard. The credit for originating the issue of standardised samples, particularly of metallurgical products, however, rests with the United States Bureau of Standards, and the value of their standards is very fully recognised throughout the world. It is a further point of interest that the Bureau of Standards sells its samples at a nominal price, this being regarded as one of the National functions of the Institution.

HEAT TREATMENT ROOM

Among other work done in the chemical building,

mention can only be made of that on the extraction of gases from metals. A considerable amount of space and equipment is being devoted to this investigation, in connection with which the Ajax-Northrupp high-frequency induction furnace is finding very useful application. The workers at the Bureau of Standards have found it necessary to introduce certain modifications into this appliance, but it is proving particularly satisfactory for experimental work of this kind. The quantities of metal melted are, of course, very small, but the conditions under which the melting takes place can be very accurately and completely controlled, since the functioning of this furnace does not involve the entry of any kind of electrode or other conductor into the metal or into the interior of the vessel in which it is melted.

OTHER DEPARTMENTS.

Of other departments of the Bureau of Standards, mention can only be made in passing in connection with a few matters of special interest. Thus, in regard to spectroscopy, reference has already been made to the advances which have been achieved in the use of the ultra-violet spectograph in the accurate analysis of metals and alloys. Dr. Meggers, at the Bureau, has carried this work to a state of very considerable advancement, his results obtained by purely spectroscopic methods comparing favourably with the analytical results obtained in the ordinary way in the chemical division of the Bureau. Other aspects of spectroscopy are being investigated from a more fundamentally scientific point of view, and important contributions to this subject have been made. Of the work of the various divisions dealing with other branches of physics, mention may be made of advances which have recently been achieved in optical pyrometry. Particular attention has been given to the disappearing filament type, which has been developed to a much higher degree of accuracy than had previously been considered possible. In another section, research centres upon Piezo-electricity in crystals, piles of crystal plates being successfully used to measure very small changes of length or pressure, by means of the electrical effects produced.

The Aeronautical Department, under Dr. Briggs, has a number of wind tunnels in operation, the largest of which has already been mentioned and illustrated. In addition, this section of the Bureau of Standards pays a large amount of attention to the design, construction and testing of aeronautical instruments, and possesses a unique collection embracing practically every aeronautical instrument that has come into use, both in Europe and America. There can be no doubt that an instrument section of this kind devoted totally to aeronautical problems is very favourably situated at such an institution as the Bureau of Standards, where experts in instrument making and use in many fields of scientific activity are close at hand and ready for collaboration.

ROLLING MILL

GENERAL.

The account which has just been given of some few of the features of the Bureau of Standards must not be regarded as representing more than impressions obtained on a brief visit lasting only a few days. The general impression gained is that of a great and magnificently equipped institution having at its command an enviable amount of resources, and very fully backed by close co-operation and intense interest on the part of the industries concerned with its various divisions. There is, further, every evidence that many of the principal workers on the staff are enthusiasts who carry on their work at totally inadequate remuneration under conditions in many other ways adverse, simply because they find in this work a satisfactory outlet for their scientific energies, and because it appeals to their idealistic sense as being service of the highest kind for the benefit of their nation. This group of enthusiasts, however, is considerably handicapped by circumstances under which the staff of the Bureau have to work. Governmental regulations in general and the pressure of political forces in particular tend seriously to hamper the work. In addition, there is the relatively low rate of remuneration, and added to this are long working hours including for nine months of the year Saturday afternoon. Such unreasonable conditions for scientific work not only tend to drive away many useful research workers, but materially interfere with the efficiency of the staff. Scientific research, above most things, cannot be measured by the number of hours devoted to it. Freshness of mind and keenness of observation are often of much greater importance than prolonged sitting over desk or instrument. A keen research worker will often work far beyond the official hours when these are comparatively short, but the enforcement of long hours day by day for six days a week seems entirely unsuited to work of this kind. That the Bureau of Standards has achieved so much excellent work, and has attained and maintained a position worthy of the national laboratory of a great nation, in spite of the difficulties and disadvantages referred to, is excellent proof of the enthusiastic keenness particularly of those at the head of the Institution. The departure of Dr. Stratton, who has become President of the great Massachusetts Institute of Technology, was much regretted both by the staff of the Bureau itself and by all those who took an interest in its welfare. The appointment, as his successor, of Dr. G. K. Burgess, hitherto head of the Metallurgy Division of the Bureau has, however, been welcomed by all; Dr. Burgess' work as a physicist and metallurgist is well known throughout the world, and his personality is such that he may be relied upon to provide the leadership which is so necessary for a great Institution of this kind, particularly if under Government auspices it is not to drift into a mere routine testing establishment.

THE ACADEMY AND THE NATIONAL RESEARCH COUNCIL, WASHINGTON.

The Bureau of Standards and the Geophysical Laboratory are but two out of many scientific institutions which have found their home in Washington, with the result that this beautiful city is coming to be regarded as the scientific capital of America. Among these institutions in Washington the Academy of Science and the National Research Council rank high in importance. Significant of this importance is the fact that at the present time a fine new building is being erected to house these two closely associated bodies. It is significant and opportune also that this new building is situated in a prominent position close to the new and splendid Lincoln Memorial. As yet the building has not progressed far enough to allow of any judgment except on the basis of the architect's drawings, but these show promise of a remarkable kind. The building is to provide not only adequate offices and meeting rooms for the Academy and Council, but will also serve as a special kind of museum provided with ample facilities for maintaining a continuous exhibition of current scientific developments and matters of interest.

The Academy dates back to 1863, and was established by Congressional Charter, while the Research Council was formed, in the first instance, for dealing with problems arising in connection with the war, in 1916; it has, however, been continued as a permanent peace organisation by executive order of the President made after the close of the war. While the Academy holds a place which, in its own sphere, corresponds with that of the Paris Academy of Science and our own Royal Society, in being devoted to the advancement of science in general and not to any particular science, the Research Council was formed originally for the purpose of stimulating, organising and utilising all the scientific activities of America for war purposes, and now continues for the purpose of aiding the advancement of science and its application to industry. Originally working with Government funds, it is now entirely independent of all Government financial support, the necessary funds being provided by private means, a considerable proportion by the Carnegie Corporation and the Rockefeller Foundation—the Engineering Foundation also playing a part. Its nature and functions are perhaps best described in the words of its own circular as "A co-operative organisation of scientific men of America, including also a representation of men of affairs interested in engineering and industry, and in the 'pure' science upon which the applied science used in these activities depends. Its membership is largely composed of accredited representatives of about seventy-five national scientific and technical societies. . . . The Council is neither a large operating laboratory nor a repository of funds to be given away to scattered scientific workers or institutions. It is, rather, an organisation which, while clearly recognising the unique value of individual work, hopes especially to bring together scattered work and workers and to assist in co-ordinating scientific attack in America in any and all lines of scientific activity. Its essential purpose is the promotion of scientific research and of the application and the dissemination of scientific knowledge for the benefit of the national strength and well-being." These objects the Council pursues in a variety of ways, some of them conditioned by the geographical circumstances of America and the wide scattering of workers which it entails. Other activities are dependent upon funds placed at the disposal of the Council by the Carnegie Corporation and the Rockefeller Foundation for Research Fellowships in Physics and Chemistry and in Medicine respectively. A glance even at the titles of the publications of the Research Council serves to show that, while rightly stressing the fundamental importance of "pure" research, full importance is attached to the industrial applications of science.

As an example of the close association of the Research Council with industry the fact may be noted that the very active and energetic Chairman of the Division of the Council which deals with the extension of research is Mr. W. M. Corse, who was for a long time intimately concerned with industrial metallurgical research, and is still associated with important metallurgical interests. Mr. Corse resides at Washington and devotes the greater part of his time and energy to this work; the same remark applies to the chairmen of a few other divisions of the Council—men who take up public work of this kind for a few years. Others are purely voluntary workers who do not live at Washington, but carry on their work by correspondence and occasional visits to headquarters.

From one point of view the very existence of such an organisation as the Research Council is in itself a recognition of the fact—recognised in so many words in some of the publications of the Council—that the output of scientific research in America, while greater to-day than it has ever been, is still inadequate, not only in proportion to what might well be expected of so large and wealthy a nation, but even for the needs of America herself. It is to assist in making good this relative deficiency that the Research Council endeavours to work; so long as the evils liable to attend over-organisation are avoided great good may be expected to result from such activities, and the writer has seen sufficient evidence in various seats of scientific activity in America to feel satisfied from his own observations that great good has already been done in a number of directions. One special activity which the Research Council has taken upon itself recently may, perhaps, be mentioned. It is the preparation of the new international critical tables. The vast task of collecting and critically reviewing the numerical data of science and technology and setting forth in the briefest tabular form the selected best values for every determined property or constant has been undertaken at the request of the International Chemical Union, although the work will cover ground entirely outside the field of chemistry. The organisation, editorial work, and even the cost of compilation and printing have been shouldered by America through the

National Research Council—but only these particular functions will be exercised in America; the collection and critical study of the actual data are being assigned to the most competent men in all the co-operating countries, these men being recommended to the Washington editorial board through advisory committees established in each country, in this way preserving the truly international character of the work as far as possible. The value of such a work, when completed, not only to the scientific investigator, but to those concerned with the practical application of scientific and technical data, will be incalculable. The present French annual tables of constants are proving of very considerable value, in spite of the fact that they are a mere uncritical compilation of all published numerical data; tables in which the figures given are based on the critical judgment of those best able to form an opinion will have a far higher value. The men of science and technology throughout the world will have reason to be grateful to the National Research Council of America for having put their hands to so great a plough, and may, at this stage, well wish them success in reaching the end of their furrow in reasonable time.

Little remains to be added to the record of impressions and views which has been given here in regard to the immense field of American science and industry. Views, in so far as it has been possible to form them at all, have been frankly stated without fear that those concerned will fail to grasp the entirely appreciative and friendly spirit which informs them. A desire for really frank criticism, indeed, seemed to be a marked feature of the attitude of Americans towards a scientific visitor, with the result that criticism may, at times, have been offered upon an insufficient basis, but a very necessary reservation to that effect has been stated more than once in these articles. No scientific visitor from the Old World can fail to be very deeply impressed by what he sees in America. The immensity of spaces, and the immensity of the physical achievements which man has dotted here and there over these vast spaces of territory, offer a striking contrast to old-world experience. America has begun in earnest to develop her immense resources, turning, as is natural, in the first place, to the direct material sources of wealth, and only slowly progressing towards a fuller exploitation of her wider resources. These, in the long run, must lie in the development of the brain-power of her manhood, not merely for the purpose of internal or even external competitive trading, but for the advancement of knowledge—for the creation of that new knowledge, sometimes called the advancement of pure science—upon which the progress of industry must, in the end, depend. America holds in her hands some of the vastest resources of the world, both material and human; as the world is constituted to-day, these resources imply, at least potentially, something like world-mastery, if need be, even in a military sense. It may be hoped that, from this point of view, such resources may never be tested, but it is none the less essential that their weight should be used in the best interests of humanity, and it may well be that sooner or later the impossibility of a policy of isolation from world politics will be generally realised.

Is it too much to hope that the men of science and the technologists of America may form such close ties with their British confréres as to exert a truly wise and helpful influence upon the course of international relations? Hitherto the lawyer and the journalist have exerted a preponderating influence in such matters, and the result can hardly be looked upon with satisfaction. Could not the newer profession—the profession whose members have from day to day to deal with the facts and phenomena of nature, whether in the laboratory or the workshop—in a calm and unbiassed manner, play a better part in these other affairs? Devotion to science and technology is an excellent thing, but if the world is to be ruined and devastated by wars, there will be little room for science or technology except in their most murderous manifestations, and even those could not long continue. British and American men of science and technology have a great common ground, and are more likely to understand one another than men of any other group or class; there lies a great opportunity before them in cultivating that mutual understanding.

The Wireless Exhibition.

No. II*.

All the latest valves which have been designed with a view to reducing the current consumption are to be seen at the Exhibition, one of the most notable being a new dull emitter valve, which has recently been introduced by the British Thomson-Houston Company. This valve works at a pressure of from 2.5 to 3 volts, and consumes a current of .06 ampères. The advantage of such a valve scarcely needs emphasising. Ordinary valves consume about .65 ampère at 4 volts or 2.6 watt, and a five valve set, therefore, needs 13 watts. With this new valve, however, such a set would only involve a consumption of .9 watt. The initial cost of the new valve, however, is exactly double that of valves without coated filaments. The valve, the makers state, has been developed to meet the need for a detecting and amplifying valve which can be operated from standard dry batteries, such as those used for operating electric bells. Detector valves of this type work with an anode voltage of 20 to 40 volts and amplifying valves with 40 to 80 volts. A standard four pin cap is used so that a special adopter is unnecessary. A larger and more powerful valve has also been introduced by the British Thomson-Houston Company. Its filament consumes 0.25 ampère at 6 volts. This valve has a low anode resistance and high amplification factor. It gives excellent results, both as detector and amplifier, and it is suitable for use in all sizes of amplifiers, especially those used with the largest size of loud speaker. An anode voltage up to 100 is satisfactory. It is advisable to use this valve with a grid biasing voltage of minus 4 or 5, when the plate voltage is at the maximum of 100. This ensures operation at a suitable point on the characteristic curve, and eliminates distortion.

* No. I. appeared November 9th.

Fig. 14—The Brown "Frenophone"

Another low consumption valve which came before our notice during our last visit to the show is the Penton valve, made by the Penton Engineering Company, of 15 Cromer-street, King's Cross. The consumption in this case is .15 ampère, and the filament pressure ranges from 4.5 to 6 volts. Taking the latter value, the consumption in watts in this case is .9. This valve, however, is sold at the usual price. Moreover, it is to be noted that the working pressure is much the same as usual, so that existing accumulators need not be scrapped. If accumulators have not already been purchased or difficulties are experienced in getting accumulators charged, Leclanché cells may be used, two parallel-connected rows of six cells in series being the most suitable arrangement. A battery of this description, the makers state, would run two valves for approximately four hours, but after that period the cells would need a rest. Like the British Thomson-Houston Company's dull emitter valve, the Penton valve does not require a special adaptor, for it is fitted with a standard four-pin cap.

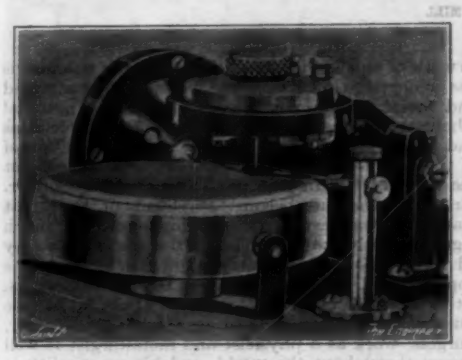


Fig. 15—Mechanism of "Frenophone"

A new form of telephone receiver, known as the Frenophone, is being shown by S. G. Brown and Co., of Victoria-road, North Acton. This receiver—which is shown in Figs. 14 and 15—has been designed for the amplification of weak signals to great loudness without loss of purity, and it is, therefore, of special value in connection with wireless telephony. The instrument depends for its operation upon the high degree of friction existing between a moving surface of optical glass and a pad of cork or similar substance. The coefficient of friction, especially when the glass surface has been lightly treated with a tacky compound, is so high that very slight changes in a constantly applied pressure between the pad and glass produce enormous fluctuations in the tangential drag between them. In practice the glass surface is made in the form of a disc, which is revolved slowly by a gramophone clock, whilst the pad consists of a small steel disc which is faced with thin cork. The pad is laid upon the glass, and its back is pressed upon by a light flexible pin, which is fastened in turn to the reed of a Brown telephone headpiece receiver. The pad is linked by "reins" to the diaphragm, which is of the usual loud-speaker type, and is fixed at the base of the trumpet. Speech currents in the receiver actuate the reed and set it in a state of vibration. These vibrations, which are imparted to the pad, appear as oscillatory changes of the steady pressure on the pad on the glass disc, and corresponding large changes of the pull on the pad by its reins upon the diaphragm result in great amplification of the speech emitted from the trumpet. The advantage claimed for the instrument is the combination of loudness with purity and the sounds of the various instruments are individualised.

Fig. 16—"Lyrian" Receiving Set

The receiving sets shown by Radio Instruments, Limited, of 12, Hyde-street, New Oxford-street, are constructed on very handsome lines, especially the firm's "Lyrian" sets. The cabinets are made in satinwood, silver birch, mahogany, antique, oak, and various other styles to suit individual requirements. These "Lyrian" sets are self-contained, the aerial batteries and loud speaker being fitted in the cabinet. The sets are designed to cover a wave length of from 300 to 4000 metres, and may, of course, be used with an external aerial instead of the frame aerial fitted in the lid. The model—shown in Fig. 16—is a small instrument for table use, but much larger and more elaborate sets are made. The receiver shown is fitted with a loud speaker and high-tension batteries, the accumulator in this particular instance being in a separate case. The model is designed for use with an external aerial, but for a range of 10 miles a portable directional frame aerial can be used. At a distance of 10 miles from a transmitting station it is possible, when working with the frame aerial, to receive speech and music on the loud speaker, and, of course, when using the headphones the range of the instrument is very much greater. The instrument shown is fitted with one high-frequency valve, a detector, and two low-frequency valves. In some of the company's sets, however, as many as seven valves are employed. These sets have three stages of high-frequency amplification, a detector valve, and three stages of low-frequency amplification. It is often stated that more than two stages of low-frequency amplification will lead to bad distortion, but with the aid of the company's intervalve transformers, the use of a third low-frequency valve is made possible. As is well known, Radio Instruments, Limited, do not use plug-in coils. All changes in wave length are made with multiple stud switches, while the tuning coil is designed to cover a wave length range of from 300 to 4000 metres.

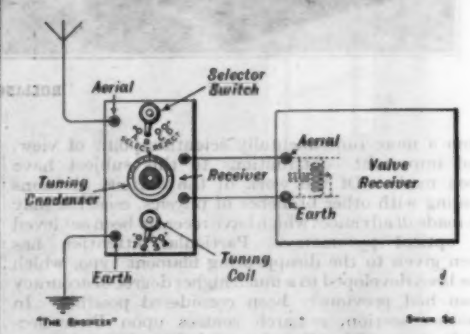


Fig. 17—Connections of Interference Eliminator

An exhibit of much interest to experimenters

and to users of receiving sets is an eliminator for eliminating interference, and it is particularly suitable for use in sea coast towns where reception of speech and music is imperfect. This eliminator, which is also to be seen on the stand of Radio Instruments, Limited, is designed for wave lengths between 150 and 500 metres. The method of using the eliminator will be understood from the diagram—Fig. 17. To reject an unwanted station the upper switch is placed in the reject position, and the receiving set is tuned in the usual manner. After the desired transmission has been heard, the lower or inductance switch of the eliminator is moved to a position in the vicinity of the stud 3 or 4. The variable condenser is then

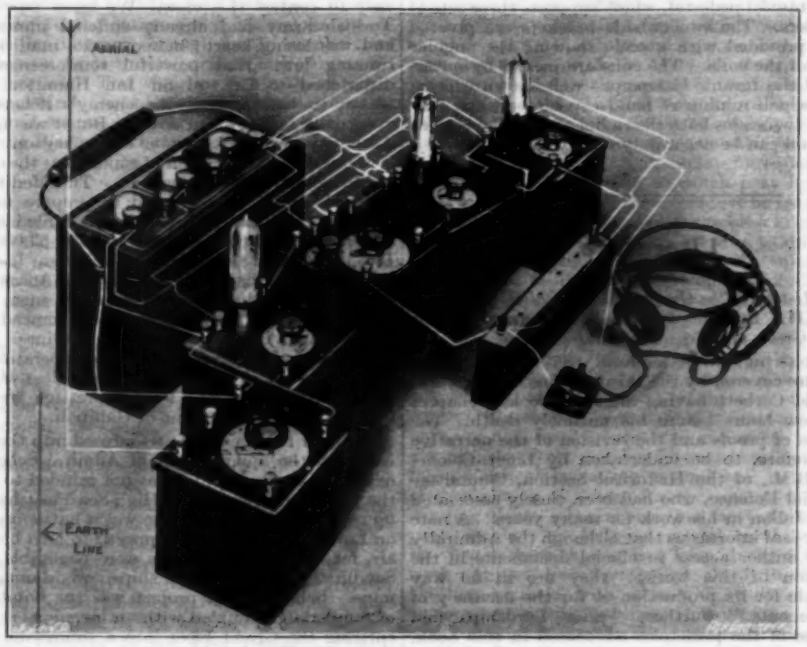


FIG. 18—METROPOLITAN-VICKERS "RADIOBRIX" UNITS

moved, and the interference from the other station is then gradually decreased. These operations are carried out alternately in small steps. To select a station the upper switch is first placed on a stud marked C, and the receiving circuit is then adjusted until the transmission from the desired station is heard, the inductance or lower switch of the eliminator being on studs 3 or 4. The condenser of the eliminator is then slowly rotated until the desired signal is increased in strength, and by readjusting the receiver and eliminator alternately good selectivity should be obtained. If, however, the desired result is not secured the upper or selector switch is moved to a lower stud and the adjustments of the tuning circuit and eliminator are repeated.

The "Radiobrix" units—shown in Fig. 18—are

has been compiled with a view to meeting the needs of the beginner as well as the experimenter who is already more or less experienced. Starting with simple circuits, it goes on to describe more complicated circuits, such as dual amplification circuits, and so forth. Sheets of squared paper are provided between the diagrams, so that the experimenter may record his own experiences in connection with each arrangement. From time to time other circuits are to be published, and users of the book are invited to fill up a coupon and forward it to the publishers, so that these new circuits may be sent to those who need them. There is a great deal of useful information in this book about methods of tuning, &c., and those engaged in wireless experiments will undoubtedly find it of considerable assistance to them.

The "Radiobrix" units are mounted in polished mahogany boxes fitted with well-finished ebonite panels. Most of the panels are 5in. square, but in a few cases the dimensions are a multiple of 5in. Complete "Cosmos" receiving sets are also shown. One of the sets has six valves and is provided with a self-contained frame aerial, and also with terminals for connecting up an outside aerial and earth-lead. The set is particularly adapted for use in flats or buildings where an outside aerial cannot be conveniently erected. Under these conditions the frame aerial is employed, and no external connections are required. When an external aerial can be used, very long ranges can be secured. With the frame

of a single knob. Non-radiating adjustable reaction coupling is also fitted. Very fine tuning is thus obtained, and maximum efficiency over the whole range of wave lengths, with the simplest possible adjustment. The crystal detector is screwed up tight, and there is no need to search for a sensitive spot. It is adjusted by means of a potentiometer,

FIG. 22—"COSMOS" TWO-VALVE SET

and once that is set it will remain for weeks without further adjustment. This type of detector gives wonderfully perfect rectification without distortion. The low-frequency amplifying circuits are specially designed to give the clearest and purest possible reproduction. A pair of head telephones is provided, and they are connected to a plug, which may be

FIG. 23—ELECTRIC SOLDERING IRON

inserted in one or other of the two "jacks" or sockets in the panel, according to the strength of signals. On inserting the plug in the first jack, the head telephones are connected to the first low-frequency valve, and on plugging into the second jack, they are connected to the second low-frequency amplifying valve. In each case, the loud speaker is

FIG. 19—IGRANIC VARIOMETER FIG. 20—IGRANIC VARIO-COUPLER FIG. 21—IGRANIC COIL HOLDER

being exhibited by the Metropolitan Vickers Electrical Company, of Trafford Park, Manchester. With the aid of these units the experimenter can build up any type of receiving set, and by the addition of units he can add stages of high or low-frequency amplification. By connecting up the units in different ways he can test all the new circuits and the time which is usually spent in mounting component parts on panels or boards can be saved. During our visit to the Metropolitan Vickers Electrical Company's stand, a very useful book of circuit diagrams was brought to our notice. The book shows many different ways in which these units can be used in the making up of circuits of various kinds. The book

aerial good reception can be obtained up to 25 miles or more from a broadcasting station, with loud speaker, and at least double that distance with head telephones. With an outside aerial, broadcasting stations can be heard clearly on the loud speaker at distances of several hundred miles. The set is highly selective; and owing to the special arrangement of the controls, adjustment is as simple as is that of the smaller valve sets. The six-valve set has three high-frequency amplifying valves, a carborundum crystal detector, and three low-frequency amplifying valves. The high-frequency vario-transformers are coupled together, so that simultaneous tuning of all three intervalve circuits is effected by the movement

cut out, and the current is cut off from the valves not in use. When the head telephones are not plugged in, the loud speaker is automatically connected to all three low-frequency valves.

The "Cosmos" valve sets are designed on the "unit" principle. The two-valve set—shown in Fig. 22—consists of a two-valve tuner unit, with the necessary batteries, telephones, &c.; and the addition of a two-valve note-amplifier unit converts it into a four-valve set. Each unit is connected to the next by a single plug, which cannot be inserted incorrectly. The units may be used by themselves, or may be assembled in an outer case of handsome design and finish, or in a cabinet enclosing a loud speaker and

horn, forming a complete self-contained loud speaker set. The sets are provided with a special dual-amplification circuit, whereby the same valve is used both for high-frequency and low-frequency amplification, thereby producing results with two valves equal to those usually obtained with three valves. In fact, two valves are made to do the work of three, with corresponding increase in magnification and range, and reduction in first cost and expense of upkeep. The sets are also fitted with a non-radiating reaction coupling of a type which complies with the Post Office requirements. The combination of these two features gives the set great sensitiveness, while the tuning is highly selective and adjustment is easy.

Many useful wireless accessories are exhibited by

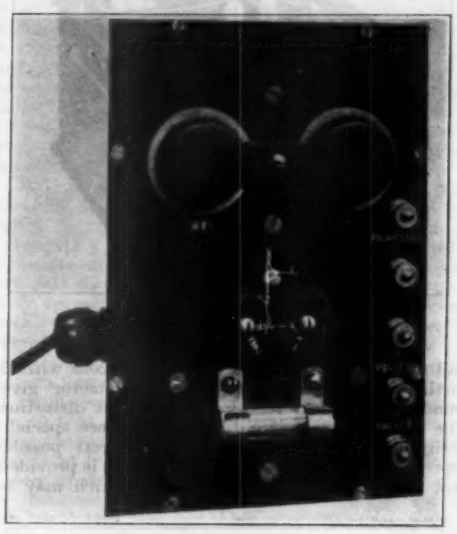


FIG 24.—IGRANIC VALVE LIGHTING UNIT

the Igranic Electric Company, of 149, Queen Victoria-street, E.C. The alternating current valve filament lighting set—shown in Fig. 24—has been designed to enable the valves of receiving sets to be worked on an alternating current supply, and accumulators are therefore unnecessary. The set is said to work satisfactorily at all ordinary frequencies, and it may be used on 100 to 110 or 200 to 240-volt circuits, and either 3 or 6 volts can be applied to the valve filaments. In the past attempts to energise the filaments of thermionic valves direct from alternating current circuits has usually resulted in a low-frequency roar in the telephones, but with this new filament lighting set all noises are said to be absent. The device can be used with any ordinary valve receiving set, but a crystal detector must be used instead of a

FIG 25.—IGRANIC INTERVALVE TRANSFORMER

valve detector. The electric soldering iron—shown in Fig. 23—is a very useful tool for wireless constructional work. It is made in three sizes and for voltages between 95 and 250. All the parts are removable, and can easily be replaced. The vario-coupler—shown in Fig. 20—is another of the Igranic Electric Company's exhibits. Tappings enable any number of turns to be brought into use, and the tappings are controlled by means of multiple switches. The external diameter is 4¼in. and the overall height 5¾in. The variometer—shown in Fig. 19—has been specially designed for use in crystal sets, the wave length range when used with a standard P.M.G. aerial being 150–600 metres. The low-frequency intervalve transformer—shown in Fig. 25—is the outcome of much investigation, and the transformer has been designed with a view to giving the best possible results when used with any standard make of valve. The coils are wound in accordance with the makers' patented process, which gives the most suitable ratio between the capacity and inductance of both the primary and secondary windings, with the result that maximum amplification is obtained without distortion. The Igranic Company's latest gimbal-mounted honeycomb tuning coil has a scale under the top pivot, by means of which the movement of the coil can be observed, and the scale is also marked with the code number of the coil. Under the lower pivot is a disc, by means of which very fine adjustment of the axial movement can be obtained. A gimbolder coil holder is shown in Fig. 21. It consists of a substantial pedestal, which supports three sets of coil holders. The two outside brackets are pivoted and are provided with a scale showing the angular position of the coils. The coils are moved by means of one of the Igranic Company's well-known friction pencils, which minimises hand capacity effects. By means of two scales both the radial and axial positions of each coil can be accurately observed.

Literature.

Official History of the Great War : Naval Operations—Vol. III. By Sir JULIAN S. CORBETT. Longmans, Green and Co. 21s. net.

OPERATIONS at sea extending over a full twelve months are covered by the third volume of this work, Sir Julian Corbett having finished the last chapter only a few hours before his untimely death. The correction of proofs and the revision of the narrative had, therefore, to be undertaken by Lieut.-Colonel Daniel, R.M., of the Historical Section, Committee of Imperial Defence, who had been closely associated with Sir Julian in his work for many years. A note on the fly-leaf informs us that although the Admiralty gave the author access to official documents in the preparation of this work, "they are in no way responsible for its production or for the accuracy of its statements." Further, "their Lordships find that some of the principles advocated in this book, especially the tendency to minimise the importance of seeking battle and of forcing it to a conclusion, are directly in conflict with their views." This goes beyond the Admiralty note which prefaced the second volume, and which merely disclaimed responsibility for the author's reading or presentation of the facts. But if the present book is not entirely official in character, it may none the less be accepted with confidence as an authentic record of events at sea during the period in question.

It begins with a survey of the general situation when the Coalition Government took office at the end of May, 1915. Neither in the naval nor the military sphere were things going well for the Allies. In the West the German lines had proved impervious to assault by such forces as we were able to bring against them at that early stage. In the East the enemy's offensive had been crowned with a large measure of success, and Russia was already showing signs of exhaustion. Meanwhile we were smarting under a severe check at the Dardanelles, where the operations originally conceived as a purely naval venture had by now developed into an amphibious campaign of the first magnitude. It was at this critical moment that German submarines appeared off Gallipoli, two old battleships being torpedoed almost immediately. In view of this deadly menace there was nothing for it but to withdraw the bulk of the Fleet behind the booms of Mudros, thus depriving our troops ashore of that covering fire from ships' guns on which they relied to smother the hostile artillery. To those who knew the facts it may well have seemed that the army in Gallipoli stood on the brink of appalling disaster. In the nick of time, however, monitors and "bulged" cruisers arrived from England, and these, being virtually immune from torpedo attack, proved effective substitutes for the battleships, which could no longer be used with safety. It speaks well for the efficacy of the bulge system that not one of the vessels so equipped fell a victim to underwater attack. This device was, indeed, as epoch-making in the history of man-of-war development as the introduction of armour had been half a century before.

One of the most interesting episodes of this period was the destruction of the German cruiser Königsberg in her lair up the Rufiji River in East Africa. As the approaches were too well defended to permit our ships to come within direct range, the task of settling accounts with the Königsberg was entrusted to the two tiny monitors, Mersey and Severn. How well they performed it is described with a wealth of detail. With aircraft spotting the fall of their salvoes, the monitors were able to pour a devastating fire into the hidden ship, which in a few hours was completely wrecked. The almost fabulous exploits of our submarines in the Sea of Marmora deserve far more space than the author is able to devote to them; but the story, even in its abbreviated form, reads more like a piece of fantastic fiction than a narrative of sober fact. We think the Germans themselves will admit that the performances of Commanders Nasmith and Boyle were never rivalled by the most intrepid of their "U-boat" captains. The summer and autumn of 1915, though unmarked by any major action at sea, were by no means devoid of liveliness in that element. There was, for instance, another sporadic outbreak of German submarine "frightfulness," of which the most significant feature was the sinking of the Arabic. American indignation at that outrage was so warm that the Berlin Government found it expedient to give a pledge of good behaviour, which was more or less adhered to for the rest of the year. At the end of December the evacuation of Gallipoli was carried out, despite the protests of those who believed that in this theatre alone was it possible to attain a success capable of ending the war almost at a blow. In the light of after knowledge it is not easy to contest this view. We know now that the Turkish army had already suffered immense loss, and was losing heart; moreover, its munitions were running low. Had powerful reinforcements been dispatched to General Sir Ian Hamilton there is reason to believe that the enemy's defence would eventually have broken down. But it was not to be. Authority decided in favour of evacuation, although it was assumed as a matter of course that the operation would entail heavy casualities. The Mediterranean hospitals alone were ordered to prepare for 30,000 wounded. But fortune for once smiled upon our arms. In the course of a few days 83,000 troops, 186 guns, and thousands of vehicles, horses, and mules were embarked at Suvla and Anzac, with a casualty list of half a dozen wounded men, and this in spite of a vigilant enemy whose advanced trenches were within a biscuit toss of our front lines. It was a masterly piece of staff work and co-operation by the sister Services. This practically bloodless withdrawal served to mitigate the loss of prestige we suffered through the abandonment of Gallipoli.

Early in 1916 new life was infused into the German Navy by the appointment of Admiral Scheer. The new commander-in-chief was not minded to continue the passive *rôle* which the High Sea Fleet had played up to then. His first stroke was a battle-cruiser raid on Lowestoft in April. It proved to be a blow in the air, for the military results were negligible, and the Seydlitz, one of his best ships, was damaged by a mine. Scheer's next project was the bombardment of Sunderland, coupled with an ingenious scheme for enticing the Grand Fleet into a submarine ambush. Out of this plan there developed the Battle of Jutland, though nothing was further from the enemy's mind than an encounter with the massed strength of the Grand Fleet. Unfortunately for Scheer, all the dispositions he made with such elaborate secrecy were revealed betimes to the Admiralty through the medium of directional wireless. Consequently, when he stole out of harbour to execute an operation that he fondly believed would fall upon us with stunning surprise, the whole of our Fleet was already at sea, waiting to give him a warm reception. It was at 2.20 p.m. on May 31st that the light cruiser Galatea signalled, "the enemy in sight." Ninety minutes later our battle-cruisers were engaged in fierce combat with their opposite numbers of the German squadron, and from then until the early hours of June 1st there was almost continuous fighting between various units of the rival fleets. No new light is shed on the summary destruction of three British battle-cruisers. It is practically certain, however, that direct hits or the flash of exploding shell penetrated to their magazines, the protection of which was inadequate. On the other hand, our return fire, though accurate and well-controlled, was rendered less effective by the failure of certain types of projectiles. Our battle-cruisers, being lightly armoured, were vulnerable to high-explosive attack, whereas the German ships were so heavily plated that none but highly efficient A.P. shell could reach their vitals.

The various moves and counter-moves of the contending fleets throughout that tremendous action are described so clearly that they are easy to follow with the aid of the diagrams attached. Sir Julian Corbett appears to have been in no doubt as to the soundness of Admiral Jellicoe's manœuvres at every stage of the battle. The inference here is that the British commander-in-chief did all that mortal man could do, short of taking inadmissible risks with the Fleet which formed at once the foundation and the pivot of the whole Allied war effort. Even as it was, the German force would probably have been annihilated by our crushing preponderance of fire had the conditions of visibility been more favourable. But by the time the Grand Fleet had completed its deployment, mist and smoke obscured the range to such a degree that targets were only visible for brief intervals, and at no time were more than a few enemy ships in sight. Those that did show up were heavily punished by our gunners. The battle-cruiser Lützow was shot to pieces; the Derfflinger and Seydlitz, battered almost beyond recognition, owed their escape from destruction to the skill of their designers, who had made them all but unsinkable. Other major units of the High Sea Fleet were severely damaged by shell fire, torpedo and mine. Admiral Scheer found himself after nightfall in a most perilous position, cut off from his base, and with every prospect of having to re-engage on the morrow with a large proportion of his ships disabled. How he extricated himself by a series of skilful manœuvres which finally enabled him to slip past the rear of the Grand Fleet

and reach home by way of the Horn Reef channel, and how our destroyers, in spite of the utmost gallantry and devotion, failed to bar his path, are events to which the historian does full justice.

The abrupt ending of the volume suggests that its author was stricken down by the hand of death before he could prepare an appreciation of the tactical and strategical fruits of the battle. But the narrative, even as it stands, is a clear and luminous account of the greatest naval action which has ever been fought. Though it may not end the controversy which has raged round the tactics employed on this occasion, it will at least enable students to arrive at a clearer personal judgment on the battle than it was possible to found on the incomplete and confused versions which have held the field hitherto. Further data relative to the action are contained in appendices, and the diagrams, though few in number, are invaluable as a guide to the intricate moves recorded in the letterpress. The whole volume makes absorbing reading, and forms, with its predecessors, an accurate and concise account of the first two years of the Great War in the naval theatre.

The Production of Air-dried Peat. Being the First Section of the Report for the years 1922, 1923, of the Fuel Research Board of the Department of Scientific and Industrial Research. London: Published under the authority of H.M. Stationery Office. 1923. Price 5s net.

THIS is an exceedingly interesting and well prepared volume. It deals with researches carried out by Professor Pierce Purcell, M. Inst. C.E., the Peat Investigation Officer to the Fuel Research Board of the Department of Scientific and Industrial Research, and by his assistant, Mr. E. J. Duffy. The former visited Canada in 1920 and Germany and Sweden in 1921 and 1922, and both he and his assistant have, in addition, studied the processes carried on in Ireland and elsewhere, so that the book as a whole may be taken as a review of the various methods of treatment practised, not only in the three countries in which peat winning is carried on to the greatest extent, but in other parts of the world as well.

After a covering report by Sir George Beilby, F.R.S., the Director to the Fuel Research Board, there is an introductory chapter on "The Problem of Winning Peat." In it, the reader is reminded that peat in an undrained bog may contain as much as from 92 to 95 per cent. of water, and that even when the bog has been drained the percentage may lie between 88 and 91 per cent. As peat containing more than 25 to 30 per cent. of moisture is not, we believe, used industrially except perhaps in gas producers, and as, for some purposes, it is necessary to reduce the water contact to from 12 to 15 per cent., the difficulty of dealing with the raw material so as to produce fuel of the required dryness will be evident even to the layman who is unaware of the particular stumbling blocks which stand in the way of treating such a substance as peat.

It is pointed out that there are only four possible methods of reducing the moisture content of the peat. They are:—(*a*) Air-drying in the open or under cover; (*b*) evaporating the water by artificial heat—the heat used being partially recovered; (*c*) mechanically pressing the water from the peat; (*d*) removing the water by electrical osmosis.

Discussing these four methods the report remarks:—"Attempts have been made and are still being made in almost every country in which peat exists, to dry the peat by the application of heat in different ways. Methods involving pressure and combinations of heat and pressure have also had extensive trials. But the fact remains that, although experimental success has frequently been claimed, there is no process based on the application of pressure, or heat and pressure, producing peat and working on a commercial basis to-day." It is explained, with reference to the electrical osmosis method that the power required to dry the peat to a point at which it may be used is so great that the process has not, so far, proved economic. Mention is also made of a process—chiefly practised in Sweden—of preparing peat powder by air drying, followed by pulverisation and treatment in ovens; but it is asserted that it cannot be said to be commercially successful, as only one factory out of three erected in Sweden is still working. We may here remark, in passing, that, later in the book, some further information is given regarding this last-mentioned process. It appears that experimental work on the production of peat powder was commenced at Bäck, in Sweden, by Lieut. Ekelund, in 1907, and that owing to the good results obtained in firing locomotives on the Swedish State railways with pulverised peat, two large peat powder factories were set up during the war period at Vislanda and Vakö. The Vakö works were shut down in 1919, but the Vislanda establishment, which is run in connection with the State railways, is still in operation. Definite figures showing the results achieved at neither factory are available, "but owing to the fact that both were erected under the inflated prices ruling during the war, the capital expenditure has been so great as to constitute a very serious burden under post-war conditions."

In view of the fact, therefore, that the only processes employed by firms selling peat fuel on a commercial basis "are those solely dependent on air-drying," the report confines itself to a critical consideration of the various methods of desiccation in operation. As a preliminary to doing so it asserts that to realise clearly the factors involved, two facts must be borne in mind at each stage: First, that for every separate ton of air-dried peat containing 25 per cent. moisture which is produced, 7½ tons of raw peat containing 90 per cent. moisture must be handled, even in the case of a drained bog; and second, that even with the best qualities of peat, the calorific value of which, on an anhydrous basis, is 10,000 B.Th.U. per pound, the 25 per cent. moist air-dried peat will have a net calorific value of not more than 7220 B.Th.U. per pound. It will be safe to take the average net value of air-dried Irish peat at 6900 B.Th.U. per pound, and taking industrial coal at 11,500 B.Th.U. per pound net, as fired, it will be seen that 1.67—or about 1⅔—tons of air-dried Irish peat contain the same number of therms as a ton of coal. A ton of coal in bunkers occupies about 45 cubic feet, whereas a ton of air-dried machine-formed peat occupies from 90 to 95 cubic feet. Hence—taking a steamship, for example—for equal thermal effect with coal, 1⅔ times as much peat by weight, or 3½ times as much by volume, must be transported. Commenting on these figures the remark is made that "if peat is to compete with coal on a calorific basis, only the minimum of labour and the minimum of capital must be expended per ton produced."

The report thereafter discusses in turn (*a*) the various types of mechanical plant for winning the peat which are at present in use; (*b*) the operations required for the air-drying of peat; (*c*) the collection of air-dried peat; (*d*) the economical spreading and collection of air-dried peat; (*e*) the cost of track for collection and transport; (*f*) the relation between depth of bog, section excavated and width of spreading ground; (*g*) the relation between length of working face, width of spreading ground and output; and (*h*) the choice of power for the operation of peat-winning plants. It is shown that most of the existing peat machines are designed to work on the surface of the bog. When a bog has been drained for some time and its surface has settled, a growth of grass or heather, coupled with a partial air-drying of the surface peat during the summer, causes the formation of a kind of surface mattress, which will bear weights of 1½ lb. to 4 lb. per square inch—216 lb. to 576 lb. per square foot—without serious settlement. Depending on the degree of drainage and the character and depth of the peat, heavy machinery may be supported on rails with a large proportion of sleepers, or, alternatively, caterpillar bearing surfaces may be provided on which the concentration of the load will not exceed the figures mentioned. The case of the Alfred Bog, Ontario, is quoted as an example of the application of the caterpillar. There the pressure due to a plant weighing 30 tons was distributed so as not to exceed 350 lb. per square foot. The plant was moved regularly and steered parallel with the face or round curves without difficulty.

The two succeeding sections of the book are devoted to "Production of Peat Fuel in Various Countries" and "Experiments on the Air-drying of Peat at Turraun" respectively, while in the final section there is given a "Consideration of Schemes for Mechanically Winning 100,000 Tons of Peat per annum." At the end are three appendices. No. I being a report of "Air-drying of Peat," by Mr. E. J. Duffy; No. II., a "Report on the Peat-winning Experiments of the Canadian Peat Committee, 1918–1921"; and No. III., "Report on Inspection of Peat-winning in Germany and Sweden," both by Professor Purcell. The volume contains as many as 145 illustrations, all of them good and most of them of an instructive character, and should prove a useful addition to the existing literature on peat. There is, however, one thing that it lacks, and that is an index.

BOOKS RECEIVED

Technischkes Hilfsbuch. By Schuchardt and Schütte. Berlin: Julius Springer.

Elasticity and Strength of Materials: Sec. III., Theory of Torsion in Shafting and Double Bending of Plates. By C. A. P. Turner.

Cargo Handling at Ports. By Bryson Cunningham. London: Chapman and Hall, 11, Henrietta-street, W.C. 2. Price 13s. 6d. net.

Modern Electro-plating. By W. E. Hughes. London: Henry Frowde and Hodder and Stoughton, 1, Bedford-street, W.C. 2. Price 16s. net.

Mercantile Calculation Tables. By A. Kirchner. London: Crosby Lockwood and Sons, Stationers' Hall-court, E.C. 4. Price £3 3s. net.

The Engineer's Draughtsman. By H. Varley. London: George Routledge and Sons, Limited, Broadway House, Carter-lane, E.C. 4. Price 5s. net.

L'Industrie du Gaz, Distillation de la Houille. By René Massé and Auguste Baril. Paris: Gauthier Villars et Cie, 55, Quai des Grands-Augustins. Price 20f.

The Inspection and Testing of Materials, Apparatus and Lines. By F. L. Henley. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 21s. net.

Materials and their Application to Engineering Design. By E. A. Allcut and E. Miller. London: Charles Griffin and Co., Limited, Exeter-street, Strand, W.C. 2. Price 32s. net.

American Lake and Coastwise Motor Ships.

FOUR motor ships recently built in the United States are of interest as being intended for inland service during the summer and for coastwise or ocean service during the winter months, when navigation on the Great Lakes is closed. The two larger boats are designed for carrying iron ore and such steel products as rails, rolled joists and structural material. They are 260ft. long, 250ft. between perpendiculars, 43ft. beam, 20ft. deep, with 14ft. draught for the canals and 16ft. draught for deep water. The main part of the hull is divided into two large cargo holds, free of stanchions, the necessary strength being given by three lines of deep beams. Each hold has a main hatch, 20ft. by 40ft. For handling the cargo there are two 5-ton electric revolving cranes with luffing jibs, having a working radius of 50ft. These vessels are of the single-deck type, with trunked deck, transverse framing, raised forecastle, and double bottom for fuel oil and water ballast. The captain's and officers' quarters are in a deck house formed with the pilot house at the after end of the short forecastle, which contains the crew's quarters. The engineers' quarters are in an after deck house. There are two pole masts, and a pole bowsprit, having a steep upward slope. This bowsprit serves as a "sight" for the steersman, since the pilot house is so close to the blow.

The propelling machinery, placed in the stern, consists of a four-cycle high-compression oil engine, with six cylinders, 23in. by 32in., rated at 750 horse-power at 135 revolutions per minute. This engine is directly connected to the propeller shaft, which carries a four-bladed screw of 10ft. diameter and 8ft. pitch. Another oil engine drives a generator for operating all the deck machinery. The main engine is designed to give a speed of 9 knots on a 14ft. loaded draught.

The two other vessels are still more interesting in that they have oil-electric twin-screw equipment for propulsion. In summer service they are intended for the long voyage between Duluth, at the head of the Great Lakes, and the port of New York, by way of the New York State Canal and the Hudson River, a run of about 1550 miles. In winter they may be run coastwise or between Atlantic ports and the West Indies. They are 258ft. long, 42ft. beam and 18ft. deep, with a loaded draught of 10ft. The cargo capacity is 2000 tons, including 600 tons in refrigerator space.

Two six-cylinder four-cycle engines of 375 horse-power are mounted with their crank shafts athwartships, and each is connected directly to a 250-kilowatt generator, the speed being 260 revolutions per minute. Both generators serve one bus-bar, so as to equalise the distribution of power to the two 250 horse-power motors, which run at 180 revolutions and drive the twin screws. Each engine has its own compressor supplying injection air at 850 lb. pressure. This propelling equipment is designed for a speed of 10 miles an hour. A special and unusual feature is that the speed is controlled directly from the pilot house under orders from the captain or the officer on duty, instead of these orders having to be transmitted to the engine-room.

Electricity is used for all auxiliary machinery, for deck machinery and for heating. When at sea the auxiliaries are driven by current from the main generators, but for port service there is a 60 horse-power oil engine directly connected to a 40-kilowatt generator and running at 300 revolutions. There is also an emergency paraffin engine and generator of 5 kilowatts capacity for lighting. The engine-room motor-driven auxiliaries include a 7½ horse-power centrifugal circulating pump, a 20 horse-power general service plunger pump, a 10 horse-power rotary balance pump, and a 3 horse-power fuel oil plunger pump, Maxim exhaust silencers heat water for the supply tanks and fuel oil in the double-bottom tanks.

A NEW ENGINEERING SOCIETY.

A MEETING was held in the Royal Hotel, Norwich, on the evening of Monday, the 12th inst., with the object of inaugurating the Norwich Engineering Society. The chair was taken by Mr. A. E. Collins, the city engineer, who gave a most interesting address, in the course of which he made several references to his early days at Plymouth. The meeting was specially noteworthy on account of the absence of formality, the company being seated in little groups round tables, while the atmosphere was thick with tobacco smoke. As a result, no doubt, there was a free interchange of ideas and a generous response to all requests.

The Society starts with a roll of some ninety full members, and a good proportion of associate members and students. The officers elected at the meeting were:—President, Mr. Arthur E. Collins, M. Inst. C.E.; vice-presidents, Mr. F. M. Long, A.M. Inst. C.E., M.I.E.E., and Mr. W. H. Scott, M.I.E.E.; hon. treasurer, Mr. C. J. Jewell, M.I.E.E.; hon. secretary, Mr. R. A. Lower, A.M.I. Mech. E., A.M.I.E.E. Members of council:—Messrs. W. Le Neve Bower, Barnards, Limited; F. W. Doggett, Mann, Egerton and Co., Limited; G. Egles, Laurence, Scott and Co., Limited; G. E. fiske, Boulton and Paul, Limited; Thos. Glover, M. Inst. C.E., British Gaslight Company, Limited; T. Lakey, Post Office Engineering Department; J. D. North, Boulton and Paul, Limited; A. R. Pank, A. Pank and Son; J. B. Willis, M. Inst. C.E., London and North-Eastern Railway.

Although it is only a few weeks since the formation of the Society was first discussed, an interesting programme of papers has already been arranged and includes:—November 26th, "Aircraft," Mr. J. D. North; December 10th, "Elevators and Conveyors," Mr. Thos. Glover; January 7th, "The New Power Station," Mr. F. M. Long, M.I.E.E.; January 21st, "Bridge Building" (types, theory, manufacture and erection), Mr. G. Kenworthy; February 4th, "The Application of Electric Motors and Control Gear to Industrial Purposes," Major S. E. Glendenning; March 3rd, "Patternmaking," Mr. W. J. Lamb, and "Foundry Practice," Mr. T. Aldous.

The Motor Car Show at Olympia.

No. III.*

THREE sizes of car were shown by the Austin Motor Company, namely, the 20 horse-power car, which has been before the public for several years; the 12 horse-power car, which is modelled upon the 20 and has now been on the road sufficiently long to prove its worth, and the 7 horse-power car, which made its first appearance at the 1922 Show. The 12 horse-power chassis is well adapted to the purpose of a compact saloon or four-seater coupé. It has a monobloc four-cylinder engine, 72 mm. bore by 102 mm. stroke, giving a total capacity of 1660 c.cm. The

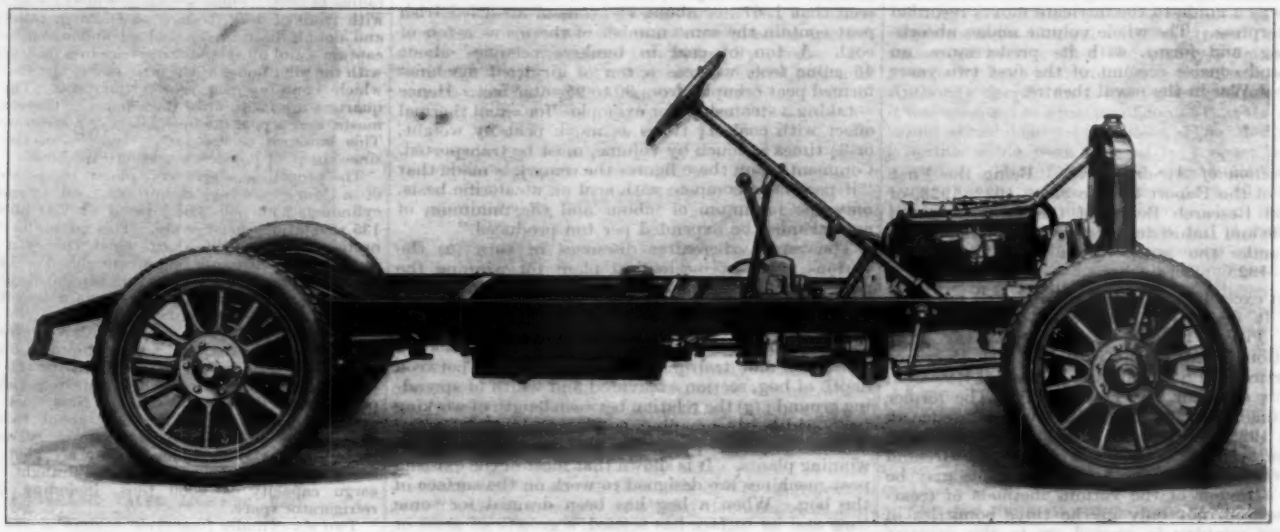


FIG. 25—AUSTIN 12 H.P. CHASSIS

clutch is of the single plate type, and is carried with the four-speed gear-box in one unit suspended at three points. The final transmission is by means of an open shaft through helical bevel gearing, mounted on roller bearings and having ball thrusts to the live semi-floating rear axle, which runs in ball bearings. Expanding pedal-operated brakes act in the rear hub drums, and the centrally mounted hand brake applies lined shoes to a drum behind the gear-box. The road springs are semi-elliptic, and the underslung rear springs are of ample length to give easy riding. A view of the Austin 12 horse-power chassis is given in Fig. 25.

The 7 horse-power chassis is illustrated in Fig. 26. This has also a four-cylinder water-cooled engine with a detachable head, the bore of the cylinders

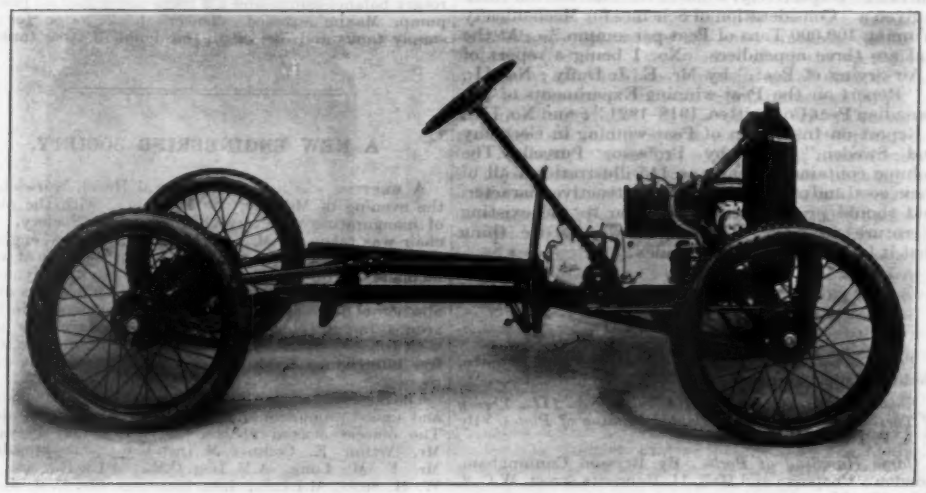


FIG. 26—AUSTIN 7 H.P. CHASSIS

being 56 mm., and the stroke 76 mm., giving a capacity of 747 c.cm. The R.A.C. rating is 7.8 horse-power. The ignition is by a magneto, cooling on the thermo-syphon system with film radiator, and the oil circulation is by means of a pump. The crank shaft has roller bearings, and the clutch is of the single plate variety. The gear-box provides three speeds forward and a reverse. The rear axle is semi-floating with differential and torque tube. It has ball bearings and thrusts throughout, the final drive being by means of helical bevel gears. The equipment of this little car includes dynamo and accumulator for lighting, electric horn, hood and side curtains. This car is fitted with a mechanical starter, which is operated from the driver's seat. A section of this appliance is given in Fig. 27. It is situated over the top of the fly-wheel, the operation being as follows:—The projecting knob A, when pushed by the foot, slides a pinion B into mesh with the ring C on the fly-wheel, against the pressure of a spring D, and then, by giving a sharp pull of the handle E at the end of the wire rope which is wound round a drum, pawls are caused to engage with the gear sleeve and so rotate the gear. The drum is re-wound by means of the spring G.

A new type of engine, called the Loyd-Lord valveless, attracted considerable attention. The claim to be valveless is, perhaps, not quite correct, except as regards cylinder valves, because the engine depends for its operation upon rotary disc valves on the crank shaft. The engine has four cylinders operating on the two-stroke cycle, and the cranks are set at 90 deg., so that four impulses are obtained per revolution of the crank shaft—equivalent to an eight-cylinder four-stroke engine. The disc valves on the crank shaft are utilised to deliver the charges of gas mixture to the working cylinders. The engine cylinders have a bore and stroke of 87.5 mm. by 83.5 mm., and the Treasury rating is 18.5, but the makers claim that it is capable of developing 60 horse-power. A feature of the engine is the accessibility of the parts. The cylinder heads are removable without letting out the water, and the pistons can be removed through the top of the cylinders without disturbing the cylinder block or crank case.

The most important development in connection with the Rolls-Royce cars is the fitting of six brakes on the 40–50 horse-power models. The brakes comprise two servo-operated mechanisms on the front wheels, two, pedal-operated, on the rear wheels, and a further separate pair on the rear wheels, which are applied by means of a hand lever. In this way the law of the country, which insists that motor cars must be fitted with two *independent* brakes, is complied with, a claim which cannot be made truthfully for some of the four-wheel braking systems in use. The brakes on the front wheels are brought into action by pedal and servo pressure, and the brake pressure all round is equalised by bevel gear compensating mechanism.

There is an increasing tendency on the part of motor car builders to fit some form of automatic device for maintaining a nearly constant temperature of the cooling water for the engines. For this purpose thermostatic appliances are used in the top water pipe to regulate the flow of the water to the radiator. A simple form of thermostat, for fitting to pump-cooled engines, was shown by Delco-Remy, Limited, 715, Fulham-road, London, S.W. 6. It consists of an expanding unit, called the bellows, which controls a simple valve. The bellows are fully contracted at any temperature up to 130 deg. Fah., in which position the valve is closed and the circulation of the water is prevented. Between 130 deg. and 170 deg. Fah. the bellows expand, open the valve, and allow the hot water from the cylinder jackets to pass to the radiator. At a temperature of 170 deg. Fah., the valve is fully opened. With pump-cooled engines, an appliance of this kind is a great advantage in starting up in cold weather, as it enables the water in the jackets to be warmed up more quickly than would otherwise be the case—an advantage which, of course, is also possessed with the thermo-syphon system of cooling. In the latter case, however, no pump is used.

The latest form of puncture-proof tube was shown by the A.P.P. Tube, Limited, 37, Southampton-street, Strand. It is, perhaps, not quite correct to call this tube puncture-proof. It is really a tube which seals itself after puncture. In section, the tube is thicker than usual, and its inner wall is coated with a special preparation of a rubber compound which, in case of a puncture, is forced by the air pressure inside the tube into the hole and seals it up. It is further claimed that this mastic compound not only seals up the hole in the tube, but also that in the cover, thus preventing the entrance of wet and dirt.

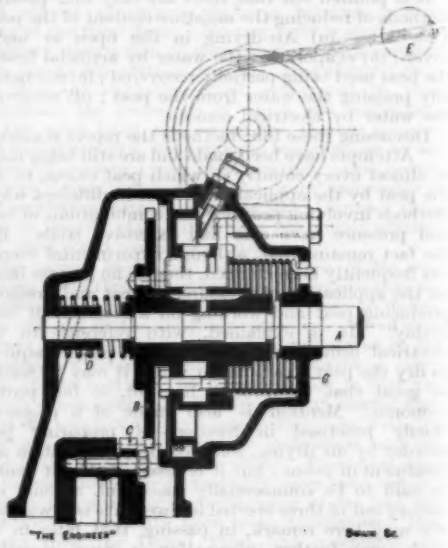


FIG. 27—AUSTIN MECHANICAL STARTER

Although there were more small six-cylinder engines shown than at previous Exhibitions, there being no fewer than twelve different makes not exceeding 2000 c.cm. in capacity, we feel that there is room for much further development in this type of engine. It is, of course, a fact that, power for power, a four-cylinder engine is, generally, more economical than one with six cylinders, but with the price of petrol steadily falling the slight difference in the cost of fuel is more than compensated for by the greater flexibility and smoothness of running which the two additional cylinders provide. The six-cylinder engine is, obviously, more expensive to produce, but with the tools now available the increased expense is com-

* No. II. appeared November 9th.

paratively trifling. The Daimler and B.S.A. companies demonstrated that cars fitted with six-cylinder sleeve-valve engines can now be turned out at prices which would only recently have been considered impossible. In this connection the 12–30 horse-power Clement-Talbot is also worthy of special mention. This delightful little car has a Treasury rating of 13.3 horse-power. With overhead valves, a disc clutch, and a diminutive three-speed gear-box, this car is a pleasure to handle in traffic.

The firm of Ruston and Hornsby, Limited, Grantham, was represented by its two standard models, one with a 16 horse-power engine and the other with a 20 horse-power engine. With the exception of the bore of the cylinders, there is practically no difference between the motive mechanism and transmission used on these cars. We understand that it has not been found necessary to make any alterations in design since last year. The 16 horse-power engine has a bore of 80 mm. and a stroke of 130 mm., the Treasury rating being 15.9 horse-power, and the 20 horse-power engine has cylinders 10 mm. larger in diameter. The crank shaft is of the drilled full pressure type, and is of high carbon steel. It is large in diameter, and is claimed to be devoid of a critical period within the range of its useful speeds. The connecting-rods are of "H" section and are balanced. They make their bearing on large diameter hardened and ground gudgeon pins in the pistons. These pistons have a point of interest insomuch as the piston guide is positioned equally above and below the gudgeon pin centre, which, the makers assert, makes for equal pressure all over the guide, and to result in the piston wearing parallel instead of tapered. Accessibility is one of the first points in the design of the engine. The sump is detachable without interfering with any other part. The front cover is detachable after removing the cam shaft pulley and the water pump, which permits of inspection and removal of the timing gears and all the mechanical parts in the timing case cover. This attribute is of value in the first erection of the engine, the double thrust race at the forward end of the crank shaft, which has to be placed accurately in relation to the crank chamber being fitted up visibly, a thing that is impossible with the three-point suspension unit. Distribution is by single helical gears, and the cam shaft, which is of hardened and ground steel, revolves in three cast iron bearings. The tappets are adjustable and work in case-hardened and ground steel guides. They are detachable for replacement. The dynamo is positively driven from a helical gear, the dynamo spindle upon which this gear is mounted being extended to form a pump drive. This pump is interesting insomuch as it possesses a bearingless impeller, the dynamo spindle extension carrying the latter. The lubrication of this engine is by pressure to every part, with the exception of pistons and gudgeon pins, which are by splash. The pump, which is of the self-priming type, draws its oil through a filter. The oil is then delivered to a long double, vertically positioned filter, and, having passed through it, is delivered through the pump head into the crank case, whence, by means of steel pipes cast integral with the case, it finds its way to the cam shaft and crank shaft bearings, as well as to all points requiring lubrication at the forward end of the engine. The oil pump is provided with an adjustable oil relief valve, which, by simply removing the oil filter gauze, can be examined for correct operation and adjustment for summer or winter, as necessary. The whole pump is removed as a unit for cleaning and inspection. The clutch is of the direct-cone type with springs mounted round the periphery. The gear-box provides three forward speeds and a reverse, and the final transmission through spiral bevel pinion has a reduction of 4¼ to 1. These cars are built as two and four-seaters, with all-weather equipment, and the 20 horse-power chassis can also be fitted with a handsome enclosed limousine body.

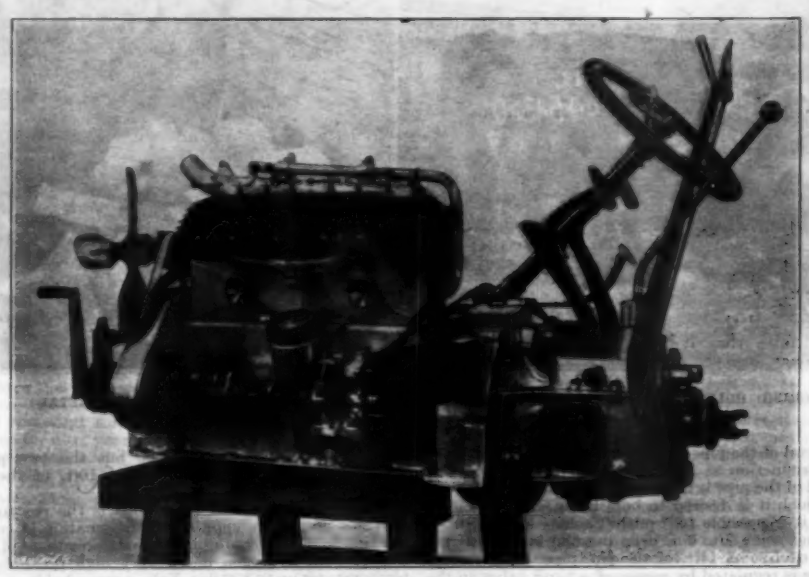


FIG. 28—RUSTON-HORNSBY MOTOR CAR ENGINE

The Russian Coal Industry.

The exploitation of the coalfields of Russia, great parts of which are still to be opened, is taking place to some extent in the following districts:—Donez region (68 per cent.), at several points in the Ural (11 per cent.), the West Siberian Kusnetzk basin (8 per cent.), and the Tjeremja basin (4 per cent.). The figures in brackets show the percentage shared by the coal districts in question in the total coal production during the months October, 1922, to June, 1923.

The entire coal industry is nationalised, but some small pits in the Donez and Moscow basin are leased to private individuals. The share of private persons in the total production of coal has increased, but does not reach 5 per cent. The pits which are being exploited by the State are under the management of the autonomous economic organisations of the various coal districts, the so-called Administration of the Coal Industry, or are combined with metallurgical and chemical trusts. Since June of this year a number of pits of the Donez region have been assigned to railways which are using coal for locomotive purposes by having them administered by a limited company, the Transportkopi, which has been specially established for this purpose and in which the respective railway administrations are represented. The utilisation of the coal which remains, after all obligatory supplies for railways and other State trusts have been deducted, is now again in the hands of the respective regional administrations, which have districts apportioned to them for the sale of coal in their hands. The Central Coal Administration has further established trading departments for the sale of coal, and private trade is almost completely excluded. The Central Coal Syndicate, which comprised all regional administrations and which was to carry out all trading operations, existed for only a short period.

Production.

During the first three quarters of the economic year 1922–23—which ended on October 1st—the coal production in the above-mentioned districts amounted to about 515 million poods (8.44 million tons) gross and 388 million poods net, against 342 and 412 million poods respectively in the same period of the economic year 1921–22. In 1913 the average monthly production in the same districts amounted to 142.7 million poods. A comparison of the production during the three first quarters of the two economic years, however, does not give a correct picture of the coal production. During 1921–23 there was an increase in the production only during the first two quarters, and the quarter which has now ended is likely to change the coal situation for the whole twelvemonth in favour of the year 1922–23. In July the production of all districts was altogether 48 million poods, and the probable total production in 1922–23 is estimated at 630 to 650 million poods. The year 1922–23 shows an improvement in so far as the figures of the various months do not show such a considerable divergency from each other as was the case in the two preceding years. For this reason no serious crisis in the coal supply were experienced, although a lack of fuel is still being felt. The conditions in the various mining districts are different, but common in all is the lack of capital, the considerable debts to workmen and contractors, and the high costs of production.

Donez Region.

Of the 347 million poods gross and 250 millions net which were produced during the months October, 1922, to June, 1923 (against 374 and 272 respectively in the same period of 1921–22), 270.5 million poods (against 282) gross were produced by the thirty-six collieries which are combined in the Administration of the State Coal Industry of the Donez basin, 57 millions by the pits of the trusts and the railways, and 20 millions by private mineowners, to whom pits are leased. At the pits of the Administration the gross and net production reached only 80 and 74 per cent. respectively of the quantities which were expected from these pits according to the working programme. The two first groups produced during July 36.6 million poods. For the period July-September the pits of the Administration are expected to yield 83 million poods, against 55 millions last year. For the first time during this year a heavy falling off in the number of workmen was averted. The number of miners in the pits of the Administration was in June 10,897, against 7530 in June, 1922. All pits together employed on June 1st and August 1st 124,357 and 116,237 men respectively, whereof 13,627 and 12,656 respectively were underground miners. On the other hand, the private requirements of the pits in the current year show an increase of 1 per cent. against last year and the production of the underground miners a decline of 13 per cent. The latter fact may be chiefly due to the considerable delay in paying the wages o the workmen. For this reason several strikes took place in July.

The difficult financial position of the Administration is caused by the considerable lack of capital and by delayed payment for the obligatory coal deliveries. Moreover, the coal prices fixed by the Central Economic Organisations are as a rule inadequate to cover the expenses. The State is obliged to make contributions, not only for productive purposes, but also for the purpose of balancing the deficits of the various coal establishments in the Donez region. The cost of production in June per pood of coal net was 0.25 pre-war gold rouble, and this very high cost is among other causes due to the deficits of a number of pits which are not sufficiently exploited but which cannot be abandoned in view of the desired future extension of production. In order to cut down the costs of production a method of concentrating the production and of bringing to a standstill a number of pits is being carried through at present. The lack of means is preventing necessary repairs and new construction as well as the repair and the erection of workmen's dwellings, the state of which prevents a further increase of the number of workmen. The opening of new or the reopening of buried or flooded coal pits was only resumed on an extensive scale last year.

On April 1st the pits of the Administration had a store of coal of about 1625 million poods, which is about three times as much as the total yearly output. The programme regarding the production for the year 1923–24 estimates a total production for 117 coal pits and 59 anthracite mines of the Administration of 413 million poods gross and 317 million poods net, of which 23 million poods are to be used for coking. Since June the railways have been unable to supply sufficient wagons for the transport of coal from the pits, and this has led to spontaneous combustion of the big coal stacks, which further worsened the financial position of the pits.

Ural Coal Region.

Coal is produced in the Ural in the regions of Kiselovo, Tjeljabinsk, Bogoslovsk, and Jegorjino (anthracite). The pits of the Bogoslovsk district belong to the big State Foundry and Mining Trust of Bogoslovsk. During the period October, 1922, to June, 1923, the four regions produced 27, 17, 9.5, and 2.7 million poods respectively, while the net output was 47.5 millions, against 53.6 and 43.2 million poods respectively in the same period of the preceding economic year. Their own requirements amounted to 15, against 18 per cent. in the preceding year. The programme for the whole year prescribed a production of 32.3, 21, 12, and 3.3 million poods respectively for these regions, while for 1923–24 the yield is expected to be 40, 24, 15, and 6 million poods. Compared with the collieries of the other regions, those of Kiselovo showed an increase in the output against last year as well as against the programme. The electrification of the Jegorjino pits is greatly impeded by the lack of capital.

Moscow District.

The coal output of this district grew to its present proportions during the years of the revolution, when the Donez basin was cut off from Central Russia. Formerly the Moscow coal was regarded as of inferior quality. In the period October, 1922, to June, 1923, the output was 42 million poods gross and 36 millions net, against 34 and 24 million poods in the same period of 1921–22. The requirements of the pits amounted to 15 per cent., against 26 per cent., and in one electrified mine to only 7 per cent. Here also the Mining Administration was able to prevent or to minimise the usual decline of the production during the summer period. But despite the favourable situation of the coal district it was not possible to find a market for the increased production, and the Mining Administration is doing everything to convince consumers that their distrust in Moscow coal is unjustified. The costs of production in this district are very high. For 1923–24 an output of 59 million poods is estimated, among which are 0.5 million tons from pits which are leased to private persons.

West Siberian Coal Region.

In the four districts of the Kusnecki region (Ansher-Sudsha, Koltshukin, South Kusnecki, and Kemmerovo) the output during the period October-June amounted to 42.1 million poods gross and 33.5 millions net, against 48 and 38.5 million poods respectively in the same period of 1921–22. The requirements of the mines were 21 per cent., against 20 per cent. in the preceding year. For the whole year 1922–23 the first three districts are expected to produce 49 million poods gross or 72 per cent. of the production laid down in the programme for the economic year. The decline in the production is the result of difficulties which are hampering the supply of foodstuffs and of the lack of capital, but in this respect a slight improvement has been noticeable since the beginning of the summer. The programme of production for 1923–24 has been fixed, with due regard for the difficult market position for coal owing to the larger consumption of wood for firing purposes, at 56 million poods gross and 45 million poods net for the first three districts and for the Kemmerovo district at 11 million poods gross. The Kemmerovo pits, about a year ago, were handed over to the autonomous American Industrial Settlement, Kusbass, and the American miners there have already carried through a considerable increase of the production. In the Tjeremcha district 20.3 million poods gross and 17 million poods net have been produced during the months of October to

June, against 32.3 and 28.5 respectively in the same period of the preceding year. The requirements of the pits were 15 per cent., against 12 per cent.

IMPORT AND EXPORT OF COAL.

Before the war considerable quantities of coal were imported from abroad into Petrograd and smaller quantities into the northern Russian ports, while Donez coal was exported from Black Sea ports. At present small quantities of English and American coal are being again imported into the above-mentioned ports. For 1922–3 an import of 10 million poods was allowed for Petrograd, but it appears that this quantity was not fully reached. In 1921–22 the coal import was much larger. Last spring a trial export of Donez coal was carried out *vid* southern ports, but the attempt was not repeated, and an organisation called Exportugolj, which was especially created for this purpose, was dissolved. A coal export trade from Russia can hardly be expected for the near future, as the present output does not suffice to cover the home requirements and as the costs of production are very high.

The New Government Graving Dock at Esquimalt, British Columbia.

THE Government of the Dominion of Canada decided some years ago that a dry dock adequate for the needs of shipping on the Pacific Coast should be built on the shores of Esquimalt Harbour, Victoria, British Columbia. The site at Skinners Cove was selected after careful borings had satisfied the engineers in charge that a solid rock foundation was available and that good conditions were at hand for handling and berthing ships in the deep waters of the surrounding harbour. Incidentally it may be remarked that the new dock is in close proximity to the shipbuilding and repairing yard of Yarrows, Limited.

The illustrations we reproduce on page 532 give a good idea of the extent of the excavation work necessary. Operations were begun on March 14th, 1921, and are progressing at a favourable rate. From the present indications it is expected that the dock will be completed some time next year. Referring to the views on page 532, Fig. 1 shows the site after the preliminary work had been started. The first cofferdam will be seen in position and all is ready for pumping out; about half the space of the dock is enclosed by the cofferdam. The view also serves to show the relation of the new dock to the surrounding deep water of Esquimalt Harbour. The view seen in Fig. 2 was taken after excavations had proceeded for some time, the direction of view being similar to that of Fig. 1, namely, looking towards the first cofferdam and the harbour. The progress of work at the head of Skinners Cove is illustrated by Fig. 3, which gives an idea of the solid rock formation and the amount of material which it has been necessary to blast out and remove. Fig. 4 depicts the state of the dock in August, when the first cofferdam was partly taken down.

The dimensions of the new dock are as follows:—Extreme length, 1150ft.; breadth of gate at the coping, 135ft.; at the sill, 125ft.; with a depth of water over the sill of 40ft. The dock will be so arranged that in case of need it may be divided by two gates into three dock sections of 400ft., 350ft., and 400ft. respectively.

The contract for the buildings, pump house, and machinery has been placed, we learn, with Hodgson, King and Marble, of Vancouver, and three electrically driven pumps will be installed. Each pump is to be designed for a capacity of 60,000 gallons per hour, and it is estimated that the combined pumping equipment will empty the dock basin in approximately four hours. The Government wisely decreed that the new dock should be large enough to take the largest ships afloat, and it is felt that on its completion a large amount of shipping repairs will be attracted to the Pacific Coast. It is hoped that the Canadian Pacific Railway will do the dry docking of its Transpacific liners at Esquimalt instead of in the Orient as at present, a procedure which is necessary on account of the lack of dry dock accommodation on the Canadian side of the Pacific Ocean.

SIXTY YEARS AGO.

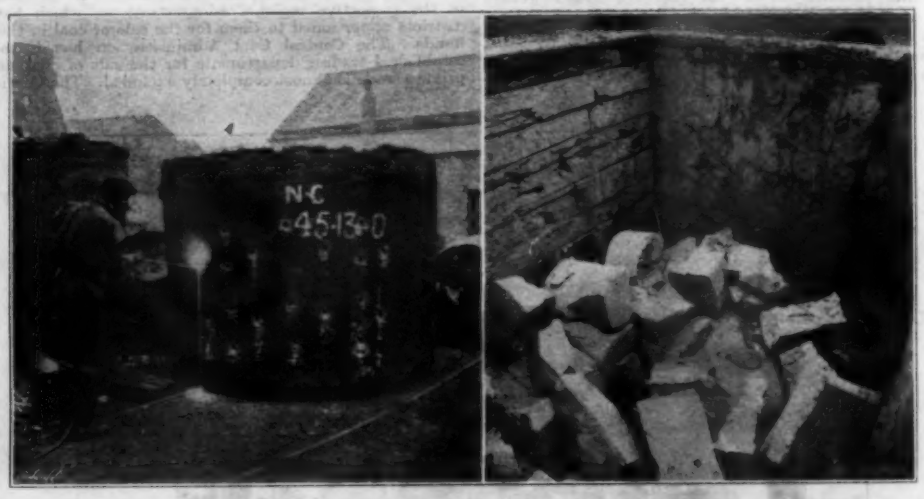
IN our issue of November 13th, 1863, we "reviewed" Samuel Smiles' "Industrial Biography," the first edition of which had then just been published by John Murray. Our review, it is perhaps of interest to note, consisted of a quarter of a column of our own writing, followed by a two-column extract from the book. The extract chosen covered the life of Richard Roberts, who, though born in 1789, was then still alive, and who, though he had enriched many by his inventions, was described by Smiles as a "sucked orange," all but forgotten, and engaged in his old age in a fight with poverty. . . . Elsewhere in the same issue we dealt at considerable length with the vexed question of gun construction. In a note it was recorded that our ships of war had suffered severe loss in the attack on the fortresses of Prince Satsuma, at Kagosima, by virtue of the unsatisfactory behaviour of the heavy Armstrong guns. The projectiles, it was stated, were, after the first day's firing, erratic in their flight, and some exploded at the muzzles or even in the guns themselves. In addition, the escape of gas at the breech was found to be a source of great danger. In a leading article, we dealt with the second report of the Select Ordnance Committee. In this our criticism of the Armstrong guns was distinctly severe. The larger sizes we described as notoriously untrustworthy, while the 3in. field guns, admittedly good as regarded range and accuracy, were characterised as complicated and costly, and as inferior in practical requisites to the French and American ordnance of the day. We even challenged the originality of Sir William Armstrong's "coil system," and alleged that all that was essential to the strength of his guns, "was invented by Captain Blakely and by Mr. Mallet, if it were not, indeed, invented still earlier." The freedom with which we expressed our views on the subject seems now to be almost more remarkable than the views themselves. . . . Reports of the meetings of three institutions were given. Before the Institution of Civil Engineers, Mr. W. Parkes read a paper describing the lighthouses recently erected in the Red Sea under the supervision of the author and in accordance with the instructions of the Board of Trade. Before the London Association of Foremen Engineers, Mr. Oubridge presented a paper entitled "A Method of Casting Guns Hollow and Cooling them from the Inside by a Current of Air." At a meeting of the Institution of Mechanical Engineers, then with its headquarters still in Birmingham, Mr. Wm. Howe described the Cornish pumping engine at Clay Cross Colliery, and Mr. R. Pilkington, of St. Helen's, dealt with the manufacture of polished sheet glass.

Breaking Up Large Masses of Steel.

A NEW method of breaking up large masses of steel—such, for example, a ladle "set"—so as to produce pieces small enough to be fed into melting furnaces, has recently been brought to our notice. The method, which is being successfully pursued by Messrs. Thompson and Co., of Wigan, consists in boring a number of holes in the metal, charging them with gelignite, and then exploding the charges after the metal has been lowered into a specially prepared pit.

The means adopted for boring the holes is interesting. A long length of ¼in. outside diameter iron pipe is connected by flexible tubing to a cylinder containing oxygen gas under pressure. The free end of the pipe is inserted into an ordinary fire bucket and, when the tip has reached a red heat, the oxygen is turned on slowly. The result is that the metal of the pipe is ignited and continues to burn with the production of a very high temperature. The flaming end of the pipe is then applied to the surface of the metal in which it is desired to bore holes, and we understand that it is possible to "push" a hole about 1in. in diameter and some 3ft. 6in. deep in solid steel with the consumption of some 14ft. of the ¼in. pipe. The correct gas pressure is regulated by means of a hand valve on the oxygen cylinder, and we are informed that the pressure employed is sufficient to keep the hole clear of molten metal.

One of the accompanying engravings shows the process of boring holes in a ladle "set" weighing 45 tons 13 cwt., while the other is a view looking down into a blasting pit after an explosion, and shows the comparatively small pieces into which the mass of metal has been split up.



BORING HOLES IN A LADLE "SET" A BROKEN-UP MASS OF METAL

The Origin of Petroleum.*

By E. H. CUNNINGHAM-CRAIG.

THE genesis of petroleum has been variously attributed to:—A. Inorganic origin: (1) Hypogene causes; (2) vulcanicity. B. Organic origin: (1) From animal matter; (2) from vegetable matter.

A. (1).—Of the hypogene origin there is little to be said. It is suggested that the action of water upon supposititious metallic carbides beneath the outer crust of the earth may have formed hydrocarbons, which might eventually condense into the complicated mixture of these bodies known as crude oil. This theory is obviously merely a speculative idea, and is not seriously considered nowadays.

(2) A somewhat vague theory of the volcanic origin of oil has been suggested, but not very definitely stated. The geological evidence advanced in favour of it is open to at least two mutually contradictory interpretations, and the theory has not found general acceptance.

This leaves the organic theories as rivals, that of animal origin being chiefly supported by chemists, while the vegetable origin theory is largely held by geologists, and has gained much ground in recent years among practical field workers.

There is a growing tendency at the present time to conduct researches upon the subject of the relations of coals and lignites to petroleum. Every country that contains either coal or petroleum, or both, can furnish some evidence, and it is becoming obvious to geologists that the two fuels have definite relations to each other.

It has been pointed out by the writer that the three main oil-bearing horizons in Trinidad have each a carbonaceous phase in some other district, and that the two phases, petroliferous and carbonaceous, approach each other very closely in some localities.

Similar evidence has been forthcoming from many countries, *e.g.*, Venezuela, Burma, Assam, Hungary and Roumania. In Assam a coal-bearing series succeeds an oil-bearing series, but the two overlap to some extent, so that oil and coal alternate throughout a zone of appreciable thickness, oil increasing in the lower strata and coal in the upper. In Hungary, owing to careful stratigraphical work, it has been proved that oil-bearing horizons in one district are equivalent to lignitic strata in another, in a different environment.

In Roumania even more striking evidence is forthcoming, as the result of further knowledge of the stratigraphy; the main oilfields are proved to lie within the areas of great Tertiary deltas, and lignitic beds in one quarter are proved to be represented by an oil-bearing formation in another. Furthermore, the writer has detected the well-known transition stage marked by extensive porcellanite outcrops.

Much pertinent evidence from Great Britain was also brought to light by the work of the Petroleum Research Department during the war, but unpublished, and the relations of oil to coal and to oil-shale have been made clearer. Perhaps the most striking evidence is that afforded by the boring at D'Arcy, near Dalkeith. This well was drilled on the theory that oil-shale denotes petroleum that is dead and buried, but that beneath an oil-shale series some free petroleum may still exist. This view was combated hotly at one time, but the drill put the question out of the realm of controversy, for not only was true free petroleum—though in small quantity—encountered, where there are no igneous rocks to distill a cracked petroleum from shales, but the two principal shows of oil were met with within 10ft. of the depths predicted.

The next point to be mentioned is the research work that has been done upon the hydrogenation of coal. By treating any coal containing a fair percentage of volatile matter with hydrogen under very high pressure and at temperatures up to 850 deg. Fah., a remarkable exothermic action is induced and a portion of the solid fuel becomes liquefied, giving as a result a product indistinguishable from heavy crude petroleum. Similar effects can be obtained by hydrogenating heavy crude oils, lighter oils being formed. The work of Dr. Bergius, though perhaps hardly yet successful as a commercial proposition when coal is treated, or, as it is stated, "liquefied," has certainly opened up a vista of great possibilities. It appears that the percentage of volatile matter in the coal is one of the determining factors controlling the reaction, another being the pressure. Pressures as high as 3000 lb. and even 5000 lb. per square inch have been used, but action may commence with a pressure of no more than 600 lb.

The value and importance of these researches of Dr. Bergius lie in the attempt to reproduce conditions similar to those that must have occurred in Nature during the formation of oil. It has long been recognised that coal is a finished product, and that oils cannot be formed from it except by distillation. The carbon-hydrogen ratio in coal is too high, though it varies, of course, in different coals. Therefore, in treating a coal to make oil hydrogen must be supplied. This Dr. Bergius has done successfully.

But before the vegetable matter has reached the coal stage it is still sufficiently rich in hydrogen, or, to put it more clearly, the carbon-hydrogen ratio has not risen too far. Therefore, in an autoclave under sufficient pressure and at not too high a temperature we should expect petroleum to be formed from vegetable matter that has not reached the coal stage. The writer, in a rough calculation made some years ago, estimated that a minimum pressure of as much as 135 atmospheres might be necessary, and that in any case 189 atmospheres would be sufficient. Dr. Bergius has shown that 200 atmospheres is sufficient, though action may begin at as low as 40 atmospheres.

It would be interesting if some supporter of the animal theory would conduct the same hydrogenation experiments with deposits containing, or supposed to contain, animal matter, to learn whether liquids indistinguishable from petroleum can be formed from them. The difficulty might be in finding deposits rich enough in animal matter, but there must have been such deposits if there be any truth in the animal origin theory. A shell-bed, a fish-bed, a coral limestone, or a foraminiferal marl, each of which has been claimed at one time or another as a probable parent rock of petroleum, might be experimented with.

* Abstract of a paper read before the Institution of Petroleum Technologists.

Railway Matters.

THE London Underground Railway Company announces that its extension from Golders Green to Brent and Hendon will be opened on Monday, the 19th inst.

THE Minister of Transport has recently authorised the construction of light railways in the city of Liverpool in connection with the existing tramways.

THE Paris *Journal* states that the Institut Colonial announces that a Bill providing for the construction of a trans-Sahara railway will be introduced in the Chamber as soon as Parliament meets.

IT is officially announced that plans have been prepared for improving the entrance to Liverpool-street Station. The carrying out of the work will, however, probably need parliamentary sanction.

ON the railways of New South Wales there are 429 signal-boxes, 22,011 lever units, 500 block instruments, 467 electric staff and tablet instruments, 973 power-worked points and signals, and 362 automatic signals.

THE position of Chief Engineer (Construction) on the Victorian Government Railways, made vacant by the retirement of Mr. Kernot, has been filled by the promotion of the Assistant Chief Engineer (Construction), Mr. C. H. Perrin.

THE New South Wales Government is anxious to have the administration of its railways investigated, and two railway experts, one with traffic and the other with engineering qualifications, are to be engaged from England to hold a full inquiry.

FURTHER appointments have now been made by the Southern Railway Company. Amongst them we note that Mr. C. Gardener, assistant carriage and wagon superintendent on the "Brighton," has been appointed manager of the carriage and wagon works at Lancing.

TWO new stations on the Ealing and Shepherd's Bush Railway have now been opened. One is at West Acton, and is situated in Twyford-avenue; the other is in Hornlane, where the Great Western line to Wycombe runs parallel with the Ealing and Shepherd's Bush line.

ON the Metropolitan District Railway there are now 80 trains an hour on the west-bound and east-bound lines combined between Mansion House and Sloane-square Stations. This density of traffic has only been made possible by automatic signalling, and is a very decided contrast to what was given in the steam-worked days, when the maximum was controlled by each block section extending from station to station, with an intermediate section between Victoria and Sloane-square.

IN addition to the completion of its electrification scheme, the Southern Railway Company proposes to spend £3,000,000 on various new works. These include the reconstruction of the stations at Exmouth, Ryde, Southampton, Barnstaple, Margate and Dover; the construction of the Totton-Fawley light railway; the reconstruction of the engineering depôt at Redbridge, and of the locomotive depôt at Exmouth Junction; the restoration of the Basingstoke and Alton light railway, and the enlargement of the company's hotel at Southampton. Three new passenger steamers have been ordered, and some new cargo boats are contemplated. Four hundred thousand tons of rails, fish-plates, &c., are to be ordered for next year's relaying and to overtake arrears of maintenance.

ON July 12th last there was a collision at West Hartlepool as to which Lieut.-Colonel Mount has recently reported. A light engine was crossed from the down to the up line when, standing on the up line in the station ahead, was a passenger train. A fixed signal governed the movement through the crossover-road and was lowered, a green flag being also exhibited. The latter apparently was not put out of the signal-box window until the engine was passing, and the driver did not see it, and so did not get the warning prescribed when a line is obstructed. A collision was the consequence. The railway company pleaded that the fixed signal was a "backing signal," and quoted a rule which said that with such a signal the driver must be prepared to stop short of any obstruction.

AT a meeting of the board of directors of the Southern Railway on the 1st inst., it was decided to proceed with the extension of the electrified area operated from Waterloo from Claygate to Guildford and from Raynes Park, *vid* Epsom and Leatherhead, to Guildford, and from Leatherhead to Dorking. The last-named section, being on the former "Brighton" line, is a new proposition, and suggests a new service between Waterloo and Dorking in addition to those given from Victoria and London Bridge. As the single-phase system of the old "Brighton" line terminates at Sutton, the two stations—Cheam and Ewell—between there and where the third-rail comes in from Raynes Park at Epsom, will be isolated as far as electric services are concerned. There is, however, a station at Ewell on the Raynes Park line.

THE Lithuanian budgetary estimates for the financial year 1924 include an appropriation of 12,000,000 litas (over £260,000) for the construction of new railway lines. It is proposed to rebuild and widen the entire railway system of Lithuania. This undertaking will be spread over several years. For strategical reasons the Russian railway lines, in the majority of cases, followed the frontier, and cross lines from the frontier were very few. The Germans, in building cross lines during their period of occupation, were guided exclusively by strategical considerations. The result is that for actual economic purposes, the existing railway system is inadequate and imperfectly planned. The construction of new lines has already been partially undertaken. Trains are now running on the recently built broad gauge line Kaslu-Ruda-Sestakavas. One of the most important of the newly projected lines is that from Siauliai *vid* Telsiai to Kretinga, where it will join the existing railway from that station to Memel, thus connecting the new Lithuanian port with the centre of the country by a more convenient route than the present circuitous one *vid* Mazeikiai. In addition to the broad gauge railways, a number of new narrow gauge lines are to be built.

Notes and Memoranda

THE *Electrician* gives an account of a peculiar accident which recently occurred on one of the single-phase locomotives on the St. Gothard Railway. It appears that the core and coils of the main transformer were taken out for inspection, and it is assumed that in replacing them the winding became damaged or that some foreign metal was dropped into the tank. In any event a day or two afterwards a heavy internal short circuit occurred which generated hydrogen and methane. These escaped from the tank, and finding their way on to the contactors were ignited. This type of accident is to be avoided in future by the use of a relief pipe, which will carry all the gases on to the roof, while an air-tight seal is to be provided between the transformer and contactor compartments.

ONE of the most picturesque and historic bridges in South India has suffered, according to *Indian Engineering*, great damage through the recent heavy floods of the Kaveri. It consisted of several hundred stone pillars, all planted on the solid rock of the river. Above it is carried a road which is the main line of communication between Sivasamudrum and Kollegal, a road wide enough for ordinary traffic. For many years there has been anxiety regarding the safety of this bridge, but, as it is the private property of the owner of the *jaghir*, no steps have been taken to deal with the matter. About fifty yards of this bridge have just been washed away, and it is likely that more will go. For several centuries it has withstood the great floods of the Kaveri, but its day is now over. It will certainly force on the authorities the need for constructing a more reliable bridge for the traffic.

A RESOLUTION has been passed by the Belfast Chamber of Commerce protesting against the recent French Decree which requires vessels with a gross tonnage of 500 and over to be fitted with a wireless receiving installation when entering French ports. The Board of Trade has sent a communication to the French Government regarding the application of this Decree to British ships, and it has been asked to accept compliance with British requirements as equivalent to compliance with French law. Attention has been drawn to the fact that British law requires a complete wireless installation and a competent wireless operator on ships between 1600 and 2000 tons gross. It is, therefore, in that respect in excess of the French law, and it has been suggested that the greater standard of safety on a limited number of ships may be regarded as a set-off against a smaller standard of safety on a larger number of ships. No reply has yet been received from the French Government.

IN an interview concerning the recent Japanese earthquake, published in the *Engineering News-Record*, Mr. J. W. Doty said that many people have a false conception of the action of an earthquake. It is not a single shock, like a quarry blast, for example, but is a series of violent oscillations extending over a considerable period—in the case of the shock at Yokohama from 40 to 60 sec. On a building whose main elements are not well tied together the effect of a quake is like that of a battering ram. During the first few seconds, if the structure be improperly designed, gaps will be opened between the floors and side walls. Into these openings will fall material shaken down from above. Beams, girders and flooring moving back and forth rapidly like the piston in a steam engine literally batter down the side walls of a building. This result, of course, cannot be produced if the parts of the structure are integral. The action on a building, during a quake, is comparable also with that of cracking a whip. The structure is actually a cantilever with its top end being snapped back and forth. It is necessary, therefore, to design the structure to resist great shearing stress.

THE construction of a high-power wireless station in Australia to give direct communication with Great Britain and America will shortly be begun and will cost £487,000. It has yet to be decided whether the site of the station will be at Sydney or Melbourne. According to a Melbourne correspondent of *The Times* the transmitting equipment will consist of a valve installation having a power in the neighbourhood of 1000 kilowatts with duplicated plant. The aerial system will be supported by twenty lattice steel masts each 60ft. high. The receiving equipment is to consist of five complete sets of high-speed commercial apparatus, capable of receiving simultaneously from five different countries, if required, while the transmitting station is in full operation sending out messages to any one of them. If the main oversea station is placed in Sydney, as is probable, there will also be installed a group of feeder stations which will communicate direct by wireless with similar feeder stations in each of the other capital cities. These feeder stations will also be equipped with electronic valve transmitters, with directional receivers and with automatic sending and receiving apparatus.

TOO little attention is given, according to Mr. H. F. Kleinfeldt, to the proper size of pebbles for the grinding of a certain kind of material to a given fineness. If the grinding consists in the reduction of a fairly coarse material, say, about ¼in. to ⅛in., and it is not necessary to grind the finished product very fine, a large pebble or ball should be employed. If the feed consists of a mixture of coarse and fine material, it is advisable to take a mixture of small and large pebbles or balls. If the material is fed in a fairly fine condition, say, from 8 to 20 mesh, and the resulting product is to be extremely fine, it is advisable to use small pebbles or balls. In other words, the idea in fine grinding is to have as many points of contact as possible with a pebble or ball of sufficient weight, so that the impact is sufficient to reduce the material to be ground. It can be readily seen from this that the ideal condition is obtained with maximum points of contact and with pebbles or balls of sufficient weight to grind or pulverise the material. This is true in either wet or dry grinding. In the case of dry grinding, the moisture content of the material to be ground is very important, and it has been definitely established that greater efficiency is obtained when the material is as free from moisture as possible.

Miscellanea.

A COMPANY has been formed in Mozambique, South Africa, with the idea of expending £60,000 on boring for oil at Inyaminga.

CONSTRUCTION has been started on the 500,000 dollar plant of the Mainland Portland Cement Company at Popcum, near Chilliwack, Vancouver.

IT is estimated that the cost of the oil pipe line to be laid between Barranca and Cartagena, in Colombia, will be approximately three million pounds sterling.

AFTER sinking operations extending over a couple of years, the Barnsley bed of coal has been reached at Harworth Colliery, near Bawtry, at a depth of 929 yards.

WITH the object of reclaiming a large strip of sea-front as building land on the outskirts of Bombay the Government of Bombay has decided to spend £400,000 annually, for fifteen years, among British manufacturers, in connection with the Back Bay development scheme—a total of £6,000,000.

AN agreement for the installation of a wireless service throughout the whole of Greece was come to on November 2nd between the Greek Government and the Marconi Company. It will be ratified by the National Assembly. A Franco-Greek company is negotiating to install a wireless telephone system between the principal towns of Greece and the Eiffel station in Paris.

THE scheme for the construction of a network of electric railways in the coal area of Cracow and Dombrowa, worked out about two years ago by the Polish Coal Mining Association, is now in progress of realisation. The Polish Electric Railway Company has just been floated with a capital of 3,000,000 gold marks. Besides the Coal Mining Association, there will participate in this venture the Coal Industry Company, the Electric Industries Bank in Warsaw, and others.

DURING the early hours of Monday, November 26th, the British Broadcasting Company is to make an experimental transmission solely for the amateurs of the United States. At 3 a.m. all the eight stations of the company will be linked by an automatic relaying system, and the programme from the London station will be sent out simultaneously from all. After a short interval each station will send out a programme on its own wave-length. If cable messages indicate success, the experiment will be repeated on the night of November 27th-28th. It is reported that 2 LO, the London station, has been heard in Cairo, Egypt.

THE production of pig iron in October, according to a return made by the National Federation of Iron and Steel Manufacturers, amounted to 592,600 tons, compared with 558,600 tons in September and 481,500 tons in October, 1922. There were 188 furnaces in blast at the end of the month, a decrease of 2 compared with the preceding month and a total decline of 35 since the end of May. The total includes 171,200 tons of hematite, 198,600 tons basic, 164,900 tons foundry, and 23,300 tons forge pig iron. The output of steel ingots and castings amounted to 702,100 tons, compared with 695,100 tons in September, and 565,200 tons in October, 1922.

THE second of the two new passenger steamers built for the Detroit and Cleveland Navigation Company was launched at Lorain, O., on October 27th. The vessel, which is to be placed in service between Buffalo and Detroit, has been named Greater Buffalo. She is a sister ship to the Greater Detroit, which was launched a few weeks ago. The two steamers will be the largest passenger vessels on the Great Lakes. They measure 550ft. from stem to stern, and are about 100ft. wide amidships. Each will carry a crew of 300, with cabin accommodation for about 1200 persons, besides space for more than 1600 tons of cargo. Each of the steamers represents an expenditure of 3,500,000 dollars.

THE "Summary of Progress and Annual Report of the Geological Survey of Great Britain for 1922" has now been issued. It contains brief accounts of the work done in many districts of England and Scotland during the past year. Re-examination of the British coalfields is the principal task in hand, and particulars are given of the new information collected in Staffordshire, Northumberland, Cumberland, Lancashire, Stirling and Ayrshire, bearing on the geology and resources of the coalfields. There are also chapters on the geology of the Northern and Western Highlands and the London district. This information is given in advance of the memoirs which will ultimately appear when the colour-printed maps are ready for publication.

LIQUID oxygen explosive has been successfully used in Colorado by the Department of the Interior in experimental mine blasting and road construction work at a cost of, approximately, one-half that of the gelatin dynamite required to do the same work. The experiments were conducted by E. D. Gardner, Mining Engineer of the American Bureau of Mines, in co-operation with a representative of the Compressed Air Corporation. A liquid oxygen explosive consists of gas black, wood pulp, or some other carbonaceous material made up into cartridges and soaked in liquid oxygen. This explosive can be detonated similar to ordinary dynamite with cap and fuse, or with electric detonators. The liquid oxygen was obtained from a plant designed to furnish oxygen gas, and was shipped to the point of use in Dewar flasks.

THE Exhibition held at King's College during the Christmas holidays, 1922–3, aroused such great interest, and was the means of raising so substantial a sum in aid of the hospitals of London, that it has been decided to repeat the experiment this year. The Exhibition will be open from December 29th to January 9th, inclusive, between the hours of 2 and 9 p.m., and experiments and demonstrations will be going on continuously during this period, as on the last occasion. Short lectures with experimental or lantern illustrations will also be given, and promises of such lectures have already been received from Professor Cheshire, Professor Winifred Cullis, Professor Eddington, Sir Richard Gregory, Professor Morley Davies, Professor Smithells, and other eminent scientists. The proceeds will be given to King Edward's Hospital Fund for London.

NEW GOVERNMENT DRY DOCK IN ESQUIMALT HARBOUR, B.C.

(*For description see page 530*)

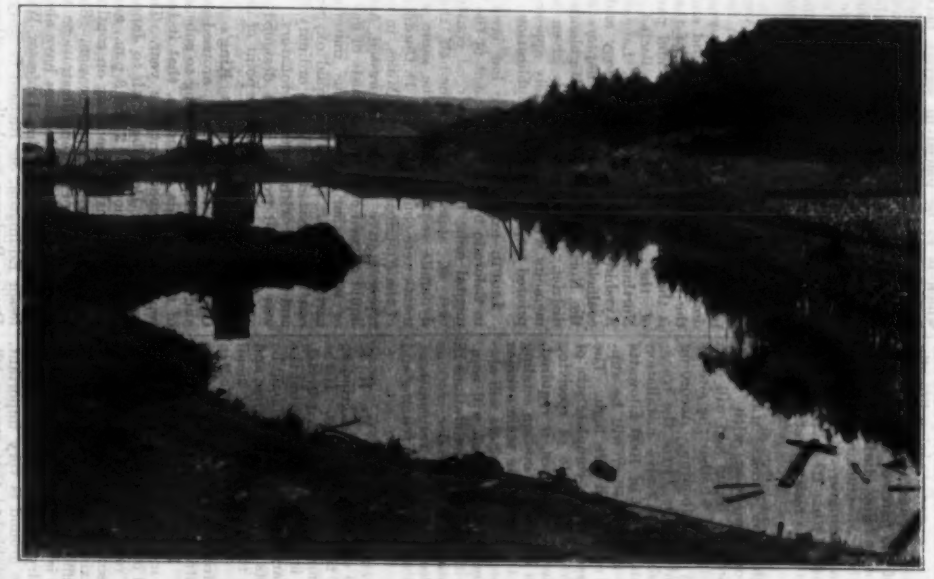


FIG. 1—THE SITE AFTER PRELIMINARY WORK WITH FIRST COFFERDAM IN POSITION

FIG. 2—WATER PUMPED OUT AND WORK OF EXCAVATION IN PROGRESS

FIG. 3—EXCAVATION AT HEAD OF SKINNERS COVE SHOWING SOLID ROCK FOUNDATION

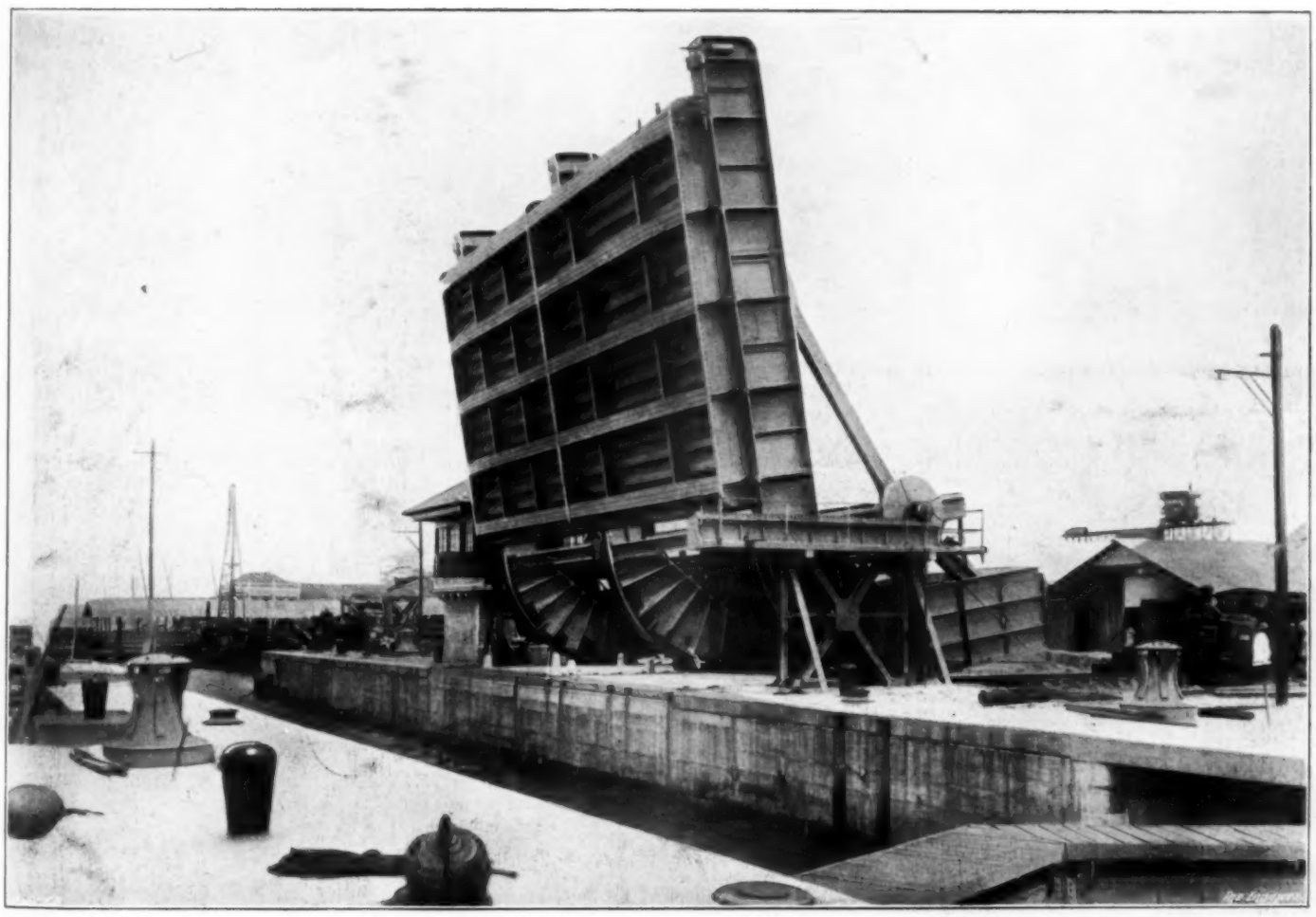
FIG. 4—VIEW OF EXCAVATION IN AUGUST, 1923—FIRST COFFERDAM BEING REMOVED

THE JOHORE CAUSEWAY BETWEEN

THE CAUSEWAY FROM THE SINGAPORE SIDE

VIEW OF LOCK AT JOHORE END

THE CAUSEWAY FROM THE JOHORE SIDE



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PUBLISHER'S NOTICES.

*** With this week's number is issued as a Supplement a Two-page Plate illustrating the Johore Causeway between Singapore and the Mainland. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

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By arrangement with Reuter's Engineering Service, The Engineer *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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THE ENGINEER.

NOVEMBER 16, 1923.

The New Naval Programme.

Discussing the cruiser situation in a leading article in our issue of October 19th, we referred to the reports then current of an impending programme to make good the Navy's shortage of such vessels, and expressed the hope that new ships would, in fact, be laid down at a date not too remote. By a happy coincidence, less than a week after the appearance of this article the Prime Minister announced that the Government had decided to replace the obsolete cruisers of the "County" class, and that it was hoped to allot the contracts for their successors at the turn of the year. Although the immediate purpose of this decision is to mitigate unemployment in the shipyards, the naval situation itself fully justifies the Government's action, which is, therefore, to be welcomed on grounds other than those of mere economic expediency. Owing to the suspension of all cruiser construction in this country since 1918, we have fallen behind other Powers in this important class of naval tonnage, and a vigorous effort will be needed if we are to make up the leeway. As we pointed out recently, no less than 36 cruisers, with a displacement of 250,000 tons, have been built or ordered for various foreign navies in the last five years, during which period not one ship of equivalent type has been laid down for the British Navy. Full particulars of the new programme are still awaited, but there is reason to believe that it embraces a large number of vessels. Two ships, it is stated, will be built at Portsmouth and Devonport respectively, and other Royal yards are endeavouring to secure a share of the work. From the Prime Minister's pointed allusion to the dearth of employment at Barrow and on the Clyde, it seems probable that special consideration will be shown to those districts when the contracts come to be awarded. The cost of each vessel can scarcely be less than £1,500,000, and may be more, for the "Raleigh" class, of 9750 tons, have averaged £1,600,000, and the new ships are expected to have the maximent displacement permitted by the Washington Treaty, viz., 10,000 tons. They will thus approximate in size to the ships they are replacing, for the first ten "County" cruisers, built more than twenty years ago, were of 9800 tons, and the six later vessels of 10,850 tons. All of these 16 ships have now disappeared from the Navy List, the last survivor, the Devonshire, having been handed over to the shipbreaker only a fortnight ago. They were built as an ocean-going type for the protection of commerce, a function which is also expected to govern the design of their successors.

That the limited number of cruisers possessing high speed and an extensive radius of action imposed a severe handicap on our naval strategy at the outbreak of war in 1914 is admitted by the official historians. It is true that twenty cruisers in all were built under three successive programmes—from 1912 onward—but none of them were actually ready when hostilities began, and in any case vessels of this particular class, having been designed expressly for attendance on the battle fleet, were quite unsuited to the requirements of ocean patrol duty. As Mr. Churchill explained in 1912, when introducing the class, of which the Arethusa was nameship, they were to be "the eyes and ears of the battle fleet by night and day; to watch over it in movement and at rest, and generally to be available for the purposes of observation and reconnaissance." In this capacity they proved signally successful. It speaks volumes for the excellence of their design and construction that nineteen out of the original twenty should have survived the war, in which all of them performed most arduous service, not a few being badly damaged by mine and gunfire. In 1916–17 were laid down the five "Raleighs," of greatly increased dimensions and armament. They were planned with a view to the protection of the ocean routes from enemy surface raiders; but with the gradual disappearance of that menace their construction was slowed down, and the war ended before the first ship of the class was ready for the pennant. The class is still incomplete by two units—the Effingham and Frobisher—whilst the Raleigh herself was wrecked in August, 1922, and the Cavendish was converted into an aircraft carrier under the name of Vindictive. Fine ships as these are, the cruisers now projected will probably surpass them in all respects. A speed of 30 to 31 knots is no longer adequate in view of the high velocities attained by recently completed foreign cruisers, several of which—*i.e.*, the American "Omahas"—have made 34 knots on trial. The Washington Treaty allows "auxiliary combatant ships" to mount guns up to 8in. calibre, but whether or not full advantage will be taken of this permission in the case of our new ships remains to be seen. At least two foreign Governments have adopted the 8in. gun for their latest cruisers. Much as the advocates of the 6in. gun—the heaviest piece capable of being worked by hand—may deplore the change, it is certain that the future lies with an armament controlled by machinery, such as is mounted already in the ships of the "Raleigh" class, which carry seven 7.5in. guns apiece. Once more the cycle of cruiser armament approaches full circle, and, just as the 4in. quick-firing gun was superseded by the well-tried and popular 6in., so the latter must now give way to a larger calibre. It is many years since an 8in. gun appeared in the ordnance tables of the British Navy. The 7.5in. model first came into our service when the battleships Triumph and Swiftsure were purchased from Chile in 1903. Apparently it gave satisfaction, for the same calibre was straightway adopted for the later "County" ships, and subsequently for other armoured cruisers. It is reassuring to know that reliance on machinery for the working of the guns in our modern cruisers involves none of the risks which hampered progress so much in the past century. Machinery, whether applied to guns or to any other part of a fighting ship's equipment, came through the late war with flying colours, and its continuous development, as applied to armament, has rendered it of great value. For instance, we understand that the latest form of control allows the heavy 7.5in. pieces to be worked with far more precision of movement than could be attained with 6in. guns manœuvred by hand. For this reason, among others, the offensive power of the "Raleigh" class is higher than is generally appreciated. So far as broadside discharge is concerned, few rivals other than capital ships would care to try conclusions with them.

While the side armour and horizontal protection of our war-time cruisers, light though it was, appears to have been adequate, there is scope for improvement in other directions. Vessels of the "Raleigh" class were the first British cruising ships to be fitted with anti-torpedo bulges, a feature which is certain to be perpetuated in all our future men-of-war above a certain displacement. In most of the foreign cruiser designs of recent date, the primary guns are placed in closed turrets. No one who has studied the details of the various cruiser actions during the war will be inclined to challenge the wisdom of this policy. The introduction of high-explosive shell has made the open gun shield a veritable death-trap. In

the daylight action at Jutland, H.M.S. Chester had most of her gunnery *personnel* laid low by splinters, while a few rapid salvoes of small shell from enemy ships that ran past the 2nd Light Cruiser Squadron after nightfall silenced practically all the guns in the Southampton and Dublin. Open shields afford indifferent protection to direct hits, and none at all to shell bursts inboard. For this reason we would strongly advocate the adoption of closed turrets for all future cruisers. The armour need not be of great thickness; considerations of weight alone would preclude turrets that were proof against the impact of heavy projectiles. But the deadly splinters that follow each burst of high-explosive shell can be kept out by 2in. or 3in. of steel. This question of gun protection is a technical detail of capital importance, which is not likely to be overlooked in the design of our new cruisers.

Cold-Brittleness.

Practical engineers have long believed, or, at least, strongly suspected, that wrought iron and steel tend to become brittle when very cold. It is known, for instance, that chains of lifting tackle are much more liable to break when the temperature is well below the freezing point than at normal temperatures. So fully is this fact recognised that outdoor lifting tackle in very cold countries, such as Russia, is deliberately kept out of use during severe winter weather. It is also believed that steel rails are liable to fracture during hard frosts, while in recent years the question has arisen of how far the strength of metallic structures, such as are used in aeroplanes and airships, is likely to be affected by the extreme degrees of cold to which they must, at times, be subjected when the aircraft rises to high altitudes. In these circumstances it is, perhaps, surprising that scientific knowledge on this matter has only quite recently become available in the form of an extensive and elaborate piece of research work by Dr. Langenberg, of the United States Arsenal at Watertown.

Dr. Langenberg, whose research has been published as one of the recent Carnegie Memoirs of the Iron and Steel Institute, has devoted his attention mainly to the study of the behaviour of various grades of steel at low temperatures under the notched-bar impact test. Concentration on this particular test for the purpose in question seems to suggest that Dr. Langenberg regards its results as an index of brittleness—and, indeed, the test is regarded in that light by many engineers and metallurgists. While we doubt the validity of this interpretation, we are not yet able to suggest a more reliable test for "brittleness," and are content, for the moment, to accept the notched-bar figures as indicating, at all events, a quality of the material whose change with falling temperature is of considerable importance. The results of the American research show quite clearly that the notched-bar figure declines very seriously with falling temperature in the case of "straight" carbon steels, but that this decline is very much less when heat-treated alloy steels are investigated. Ordinary wrought iron was not included in the American tests, a fact which, in view of the wide use of wrought iron in lifting chains, is to be regretted. On the other hand, if one may argue from general principles in such a case, it would seem probable that in wrought iron the change would be even more marked than in mild steel. The fact that mild steel deteriorates much more seriously with low temperatures than does heat-treated alloy steel at once suggests that the trouble resides in the ferrite crystals, which are present to a considerable extent in ordinary untreated "straight" carbon steel, but whose development is largely checked or prevented in heat-treated alloy steels. If this be the case, then wrought iron, which consists, practically entirely of ferrite crystals, may be expected to show even greater changes than mild steel. If, then, we accept the indications of the notched-bar impact test as being of value as a guide to the service behaviour of these materials, Dr. Langenberg's results lead to a somewhat difficult situation. For steel rails which have to serve in very cold climates, the use of heat-treated alloy steels would seem to be indicated—but such a suggestion is out of court, at all events, at the present time, on account of the relatively prohibitive cost of the higher grades of material. Whether it would, or would not, be feasible to employ heat-treated straight carbon steels is still a question of cost, but where fractures in cold weather are common, the extra expenditure might be worth considering, provided we still ascribe these fractures to "cold-brittleness" of steel. When we consider chains, the situation is even more difficult. Wrought iron offers such great advantages in regard to welding that it would be difficult to substitute for it any grade of steel, unless some form of modern autogenous welding might be relied upon to replace the standard blacksmith's weld. Such a step would need very careful consideration, but the proposition is one which may have to be faced. There are, however, two considerations which must not be forgotten in connection with this whole question. The first, to which we have already alluded, is the extent to which we can regard figures of notched-bar impact tests as indicative of brittleness in service, and the other is whether the degree of "brittleness" thus indicated is sufficiently serious to account for the failures which are known to occur in practice from time to time at low temperatures. Thus, to take an example somewhat on the extreme side of Langenberg's results, we may consider his steel containing 0.36 per cent. carbon. At 70 deg. Fah., this steel gives an average figure, under the Charpy impact test, of 31; at 32 deg. Fah., the figure falls to 16, and at 0 deg. Fah., it becomes 13. It is true that these results indicate a definite deterioration at low temperatures, but the differences, in reality, are not as striking as these figures by themselves might suggest. For comparison, we may quote the Charpy impact figure for the same steel, again at 32 deg. Fah., in the heat-treated condition. It is 366, and only falls to 344 at 0 deg. Fah. In this latter condition the effect of low temperature is obviously very slight indeed. In the annealed condition, as represented by the low figures quoted above, the proportionate difference is greater, but it would hardly appear to be sufficient to justify any expectation of very wide differences in service behaviour. It must be remembered that the fact that at 70 deg. the annealed steel gives an impact figure of 31 and at zero Fah. gives only 13, does not mean that the "strength" of the steel in the two conditions is as 31 to 13, or even approximately so. These figures are not sufficiently definite in their indications to bear that interpretation; where we have impact figures which differ by large numbers, we can rely upon a corresponding difference—mainly in one kind of ductility in the steel. But where the figures are small, we cannot argue as to proportionality. Actual determinations on different notches in the same specimen will vary by, perhaps, 10 or 12 units—usually kilogramme-metres per square centimetre.

Hence, we may hazard the opinion that although Langenberg's figures show a real difference between annealed steel at room temperatures and at 32 deg. below freezing, this difference *may not* be so large as the ratio of the figures suggest, and we should not at once conclude that his data explain the whole thing. If this view be correct, we are forced to adopt one of two alternatives; either the Charpy test does not truly exhibit the brittleness of the cold steel, or the failures in service arise, in part at least, from other causes. Such other causes are not difficult to suggest. In a railway rail, the hard-frozen condition of the road bed may expose the rails to much more severe shocks than any which occur under normal conditions. In a lifting tackle, links may be frozen together in such a way that, when the load comes upon them they slip to a serious extent and cause just that kind of shock which is most apt to be fatal to a wrought iron chain. All that can be said, it seems, is that the whole matter has not yet reached a conclusive stage, although much interesting light has been thrown upon it. Further investigation is clearly needed, not only by the metallurgist, but also by the practical engineer. If the latter can show that fractures occur at low temperatures even when all adventitious causes, such as those we have suggested, are strictly eliminated, then it is for the metallurgist to provide the remedy.

Our Mineral Statistics.

In accordance with our customary procedure we give herewith a review of our mineral output for the year 1922 as recorded in the "Second Annual Report of the Secretary for Mines and the Annual Report of H.M. Chief Inspector of Mines with a statistical Appendix to both Reports." Last year we noticed at some length the alteration in the form of the report from those which had preceded it in the days when there was no Secretary for Mines, and there is no need to go again over the same ground. Compared with the report for 1921, there are only a few minor alterations dealing with the classification of mineral bodies, and no signs of any return to the detailed form referring to individual mines which was so prominent and useful a feature of the pre-war reports of the Chief Inspectors. Special note should be taken of the fact that for the first time Irish statistics are not included, an omission which must be borne in mind by those who read hurriedly, because the output figures of certain minerals, notably barytes, bauxite, bog ore, and diatomite are largely affected. Last year we questioned the inclusion of bauxite, among "non-ferrous ores" rather than among minerals used in the "chemical and allied industries," though we recognised that the case was one of some complexity. This year the difficulty has been easily overcome by the non-appearance of bauxite, as the mineral is produced only in Co. Antrim, the bauxitic clay of the Ayrshire coalfield apparently not being marketed as bauxite. With regard to the classification of limestone, which has large metallurgical and chemical as well as building and road-making uses, we had something to say last year, and we note with interest the remark in the Secretary's for Mines report that, though it had not been found possible in that report to separate the limestone used in building and road making from that absorbed by other industries, such separation would be made ultimately. This remark applies also to dolomite, which is being increasingly quarried as a basic material for lining steel furnaces. While on this topic, though we are not advocating any minute division of our limestone output into its several uses, it seems hardly possible to ignore the large tonnage which is burnt to lime for use in the agricultural, building, and chemical industries. In the American Mineral Statistics one finds the total production of lime and the amounts used by the several main industries, though whether such detailed information is worth the trouble of collection or not, we do not express an opinion. The fact, however, seems worthy of mention.

Without wishing to adopt the *rôle* of the carping critic, we feel constrained to refer to what we consider two misfits in the classification of minerals according to their uses. The first case is that of calc-spar, which is found under minerals used in the chemical and allied industries. Possibly some of the largely increased output of the spar, which is crystalline calcium carbonate, may go to chemical works, but last year's activity was very largely due to contracts made with housing scheme authorities for pebble-dashing purposes. Of the total of 6422 tons, 5533 tons came from Derbyshire, 865 tons from Shropshire, and 24 tons from Flintshire, all of it being from old lead-mine workings, where it is a common vein stuff. It would, therefore, seem more correct to put it under the heading of building and road-making materials. In fact, it might appropriately change places with chert and flint because, although to the annoyance of motorists, these materials in their lowest grades are used in road mending in some districts; chert is mined or quarried primarily for use in the pottery manufacture, where in the form of large blocks it is used for grinding flints in the wet pan. Our objection does not, of course, amount to very much, because the road-making schedule also includes all other purposes, but it seems worth while to refer to the matter. We note that the average price of the English chert and flint at the mine or quarry is given as 8s. 6d. per ton, while the Welsh product, described as ground flint, is put at 41s. 3d., and we would say that while the latter figure refers to a specific material, the former is obtained by lumping together the best Derbyshire and Swaledale chert with ten times the amount of cheaply obtained chalk flints, giving a mean figure of dubious value.

Touching on another point, we note that statistics regarding the output of Fuller's earth are withheld, "the information not being available for publication." In reports of past years there used to be one or two cases where it was stated that figures were not obtainable, nothing being said about being available for publication. The output of this particular clay used to be over 100,000 tons a year, a little being mined in Somerset, but the bulk coming from quarries in that county and Surrey, and presumably there is some good reason why the figures for output given formerly are now withheld.

The parlous state of our copper mining industry has found frequent reference in former reviews, and to-day we shall merely mention the fact that no copper ore at all was produced in 1922. The same thing has occurred in the case of gold mining in Wales, an industry that has always had its ups and downs. In regard to gold, however, it rather looks as if we shall witness a revival, not in the Dolgelly region, but at Pumpsaint or Punysant, in Carmarthenshire, where gold mining is known to have been carried on by the Romans. The scheme under present consideration concerns an alluvial proposition in the Cothy Valley, where experts consider that dredging would prove profitable.

Looking at the outturn statistics generally, one need hardly state that coal is far and away our most important mineral, the production of 249,606,864 tons being a large increase on the figure for 1921, which was 163,251,181 tons. Of other minerals, both metallic and non-metallic, it is satisfactory to note an increased production, though, especially with regard to lead, tin, zinc and iron, there is nothing to boast about when we bear the pre-war figures in

mind. Still, the general improvement is matter for congratulation, as in most cases it is due to a more reasonable attitude of the workers on the wage question, as well as to a rise in values.

The names of the various Advisory Committees appointed under Sec. 4 of the Mining Industry Act, 1920, are given in Appendix C, a notable omission being that for the metalliferous mining industry, which committee is at present, we are told, being reconstituted.

Coal.

Turning now from the general to the particular, we shall make an alteration in the procedure adopted in all previous reviews and make our comments upon individual minerals according to the classification adopted in the report, and not in alphabetical order. We thus begin with coal instead of arsenic, and note with interest the developments in progress for winning coal from the limestone series of North Northumberland by the Scremerston Coal Company and the Co-operative Wholesale Society, Limited. Important extensions, to work the concealed coalfields to the east of the old Yorkshire and Nottinghamshire coalfields, are in progress. Especially are they noticeable in the Sherwood Forest area—that Mecca of the nature lover—where the Clipstone Pit is now winding coal from a depth of half a mile, and where the new Ollerton Colliery of the Butterley Company will follow suit in the course of a month or two. It ought to be said that all care is being taken to preserve the natural amenities of the Dukeries, as far as is consistent with such an industry as coal mining, and we may say that in the case of the new Budby Pit of the Bolsover Company, which will be located not far from Thoresby House, there will be no boilers or chimney stack, as all power required for winding, &c., will be electric, the current being brought from a station at a colliery some distance away. Doubtless, the next few years will see new collieries still further to the East now that the coal measures have been proved. Considerable activity is reported from the South Wales coalfield, especially on the properties of the Powell Duffryn Steam Coal Company and the Ocean Company, the Cardiff Collieries, Limited, and North's Navigation Collieries being among those which also have important developments on hand. The formation of the private company of Pearson and Dorman Long, Limited, with the early prospects of new sinkings, is, of course, an important matter for the Kent coalfield, where we note that the Tilmanstone Colliery, the oldest of the inland concerns, is now deepening its shafts to the lower seams.

About 16½ million tons of coal were used in the manufacture of gas, much the same figure as in 1921, but with regard to the carbonisation in coke ovens, both of the beehive and recovery type, the figure was 13,290,580 tons, against 6,883,112 tons, thus testifying to the increased demand for coke in the blast-furnaces. The briquette industry showed an improvement on that of the previous year, though the great rise which has occurred this year in the price of pitch cannot fail to be reflected in the figures of the next report.

Metalliferous Ores.

Passing on now to the group comprising metalliferous ores, we may refer first to iron as the most important. The output from all districts was 6,867,512 tons, with the average value at the mine of 7s. per ton, against 3,477,955 tons at 12s. 8d. in 1921. This improvement, though striking, still compares badly with the pre-war output of about 15 million tons. As regards the different districts, the most notable increase is in the Jurassic ironstones quarried in Lincolnshire and the Midlands, these ores being cheaply worked in comparison with those in the Cleveland district, which have to be mined. The Cumberland and Furness non-phosphoric hematite amounted to 839,801 tons, against 335,649 tons in 1921, but it is to be feared that the improvement shown is not being sustained this year, more than one of the main workings having closed down. The imports of iron ore were 3,472,575 tons, a decided advance on the 1,887,642 tons of the preceding year. The Board of Customs and Excise returns of the country of origin are not given in the report, but, no doubt, Spain continues to be the main source of supply, though large and increasing quantities of the magnetite ores of Swedish Lapland come to our eastern and western ports. The Mediterranean ores which have long come to us are now augmented by the hematite from the Riff, shipped from the port of Melilla. With regard to manganese ore, the impetus given to the output in North Wales during the war has, naturally, not been sustained in face of higher grade imports, and the production, all from Merionethshire, in 1922 was only 250 tons. The imports came to 329,396 tons, quite a considerable quantity of rich ore now coming from Mount Sinai, where the company formed just before the war is working under favourable conditions.

Uranium ore to the amount of 393 tons was obtained in Cornwall, while the tungsten ore raised from the same county only totalled 3 tons. The report mentions that during the year a plant for the extraction of radium salts and uranium oxide from pitchblende was completed by the Société Industrielle du Radium at the South Terras Mine, Cornwall, the mineral having, hitherto, been sent to France for treatment. So now there is another competitor to the famous radium factory at the St. Joachimstal mines in Czecho-Slovakia. Copper ore, as has already been mentioned, was not mined during 1922, but the production of copper precipitate from the drainage waters of the abandoned mines in Devonshire and Anglesea went on, the only point of note being the fact that the low yield of 56 tons at Amlwch was doubled by Devon. A more important metal is lead, and it is satisfactory to note that the output of concentrates rose from the low level of 6787 tons in 1921 to 11,079 tons in 1922, the rise in the price of the metal and the reduction in the smelters' returning charges being important factors in the recovery. The average assay is given as 80 per cent. metal, which is a very good recovery if all slimes and low grade ore are included. The Boltsburn mine of the Weardale Lead Company did not retain its place as the principal producer, this position being taken by the Queensberry mine, Dumfriesshire, though, rather curiously, this mine is not included in the short list of principal producers mentioned on page 19 of the report. The Boltsburn mine comes a good second, followed by Mill Close, Derbyshire, and Leadhills, Lanarkshire, An interesting feature of this year's report is the evidence of the progress which is being made in the re-opening of old lead-mining districts, good returns being shown by the Sipton mine, of Allendale, Northumberland, and by Rodderup Fell mine, Cumberland, while, though only 58 tons of ore figure for Perthshire, there is no doubt that the great developments which are taking place at the re-opened Tyndrum mine will have a considerable effect on the future output of lead ore in Scotland. A depressing feature of the lead returns is the almost entire suspension of activity in the Halkyn Mountain district of Flintshire, where it is evident that there can be no resumption until the new deep level drainage tunnel is completed. With regard to this very urgent problem, we are told, in the Secretary for Mines report, that the formulation of some practicable scheme to enable the industry to be restarted within a reasonable period was engaging attention at the end of the year. In last year's report it was mentioned that progress was delayed for want of fresh capital, there being still a little more than a mile to be driven. It must be quite ten years since this important work was begun with insufficient capital, and it seems a great pity that some of the money spent of late in work which is of no immediate or national importance could not have been diverted to work of this sort. The money for the tunnel of Shropshire Mines, Limited, was found by an enterprising capitalist, and we see the result in the position of that county at the head of our barytes producers. The output of 565 tons of ore at the Greenside mine, Westmorland, is a satisfactory indication that the re-opening of this old mine, after its war-time vicissitudes, is likely to be fully justified. Derbyshire Mill Close, under its new ownership, remains the only producer of note, and we are unable to see any justification for the Press report of a revival in Derbyshire mining, though certainly there are one or two new ventures on foot. An important move is the recent taking over, by the Weardale Lead Company, Limited, of the Upper Allendale mines, as this portends important developments and economies.

A remark or two on our depressed zinc mining may conveniently follow here, as the ore is all obtained from lead mines. The 1922 output of concentrates was 1620 tons, a small amount, though double that of the preceding year. The reopened Threlkeld mine in Cumberland is now producing both lead and zinc ore, and a certain amount of complex zinc ore has always been obtained at the Mill Close and Queensberry mines. It is interesting to note that the Isle of Man produced 540 tons against nil in 1921, when the Great Laxey Mining Company sold up and retired owing to recurrent labour troubles. This mine has been a large producer in the past, and was showing signs of poverty at depth, but we have no doubt that those who have now taken it over will still find a good deal of workable ore. The Secretary's for Mines report states that in spite of the increased demand for spelter and the rise in price, zinc mining in Great Britain remained under a cloud—and under a cloud, we may add, it is likely to remain during the further seven years, when large quantities of Australian zinc concentrates come to England to be smelted on account of the Government ten-year contract. The present activities of the Vieille Montagne Company in Cumberland, are limited to a little lead ore production at the Nentsbury mine, their zinc mines at Nenthead being entirely closed down. There is a possibility, however, that work may be begun again, and it is satisfactory that this important company has not cleared out of England altogether. In Scotland the Wood of Cree mine, Kirkcudbrightshire, belonging to Ore Supply, Limited, has been abandoned and the plant dispersed, but zinc ore is expected to be part of the regular produce of the Lyndrum mine, Perthshire, referred to under lead.

It is hardly necessary to say that owing to various adverse circumstances tin mining in Cornwall has been much depressed, the total output of dressed ore or "black tin" in 1922 being only 650 tons against 8355 tons in 1913. Prospects at the moment, however, have much improved, the Trades Facilities Act having been taken advantage of by several of the mines for unwatering, sinking, &c., and stagnation will shortly be succeeded by activity on several properties. The importance of the bearing of this fact on the labour question is apparent when we note that last year 880 persons were employed against about 8800 in 1913.

Arsenic, Barytes, &c.

Turning now to the minerals used in the chemical and allied industries, we may refer first to arsenic, the production of which is closely associated with that of tin in Cornwall. As so much of our arsenious acid is obtained as a by-product in tin mining and not from arsenical pyrites separately mined, it is unfortunate that the stoppage of tin mines reduced the output of arsenic for which there was a ready market at advancing prices, the figure in December for arsenious acid being £65 per ton. The call from America for arsenical insecticides for the cotton plantations was the main cause of the rise. The total output of white arsenious acid and arsenic soot was was 978 tons, of which a fair quantum came from the Wheal Jewel and Marytavy Mines Company, Limited, of Devonshire. The output of barytes sulphate and carbonate was 40,949 tons, against 24,669 tons in 1921. Both in production and average value per ton the sulphate and carbonate are lumped together, and there is no guide to the relative amounts of each, but against this drawback it is satisfactory to note that the term barium compounds has been removed from the letterpress. It must not be overlooked that in 1921 Co. Cork, with 4516 tons, was the second largest producing county, and that the Irish output is not included in the statistics under notice. The number of counties producing barytes last year was further reduced to eleven, though in regard to some of the mines which closed down it should be said that they were suffering from the after effects of the coal stoppage in 1921, when flooding caused damage and depletion of capital resources. Shropshire easily maintains its possession as the largest producer, with 18,483 tons. Northumberland—mainly witherite the carbonate—Durham, Derby, Yorkshire, Devon, Montgomery, and Westmoreland following in order of merit. During the war the mining industry flourished owing to cessation of imports, but now we note that 4929 tons of lump were imported, the rest of the total import of 34,245 tons evidently being ground barytes ready for use. This import figure has about the same relation to the home production as was the case before the war, and it is somewhat disquieting, as it was thought that the improvements made in the milling plant would enable Britain to be self supporting, there being no question of the reserves of mineral available. According, however, to the report, there is still much room for improvement in our milling plant in order to enable the mines to meet foreign competition. There is also the question of the quality of the crude mineral for, while some of the aggregate tonnage is the very best quality, there is a considerable amount of which the purity is much nearer 90 than 100 per cent., and the bulk of the users want the pure mineral.

The important china clay industry of Cornwall and Devon showed a great recovery from the acute depression of 1921, largely owing to expansion of the export trade, the American demand being a prominent feature. The output was 666,834 tons, whilst of other local material the returns are 38,921 tons of china stone and 12,984 tons of mica clay. Although we continue to import felspar from Norway for use in the potteries, it is interesting to note that as a result of war-time investigations, it is now being quarried in Cornwall, Salop and five Scotch counties in conjunction with igneous rocks. The output of iron pyrites, presumably coal brasses from collieries, was 5669 tons, against 3943 tons in 1921. There are no figures relating to our imports, which in some former years reached almost a million tons. Instead of the cupriferous iron pyrites which a few years ago was commonly imported, the tendency to-day, since the price of copper has fallen, is to contract for iron pyrites in which the amount of copper is too small to affect the price.

Of the minerals used in road-making and for all other purposes, we shall only mention limestone, the output of which at 9,418,678 tons was 28 per cent. above the 1921 figure. Operations under the Government agreement with Messrs. S. Pearson and Sons, have now come to an end, the Hardstoft well in Derbyshire and the D'Arcy well in Midlothian having been taken over by the respective landowners, and the non-producing wells plugged. Of the above-mentioned wells only the former can be considered as having any commercial importance, though the yield in 1922 was only 125 tons against 342 in the preceding year. The more important oil shale industry of Scotland enjoyed a considerably better year than 1921, the output amounting to 2,603,996 tons, and giving a much needed fillip to employment.

The National Joint Council, representing the Trades Union Congress General Council, the Labour Party National Executive and the Parliamentary Labour Party, has made formal application to the Railway Rates Tribunal that, as authorised by Sec. 24 (4), the Tribunal be enlarged when passenger fares are considered, by a person to be nominated by the Council. The Council recognises that this enlargement would necessitate a corresponding additional appointment from the railway panel.

The History and Progress of Metallurgical Science.*

By SIR ROBERT HADFIELD.

PROMINENT BIRMINGHAM MEN OF THE PRESENT DAY.

Having reviewed the work of Birmingham men of the past, reference may now be made to some of those of the present day. For want of space it is not possible to give here the names of all those deserving of mention, or of those whose work does not come within the scope of this Address. Other living authorities, too, are mentioned in the section devoted to your University.

Naturally, one of the first names in our minds is that of Sir Oliver Lodge, D.Sc., LL.D., F.R.S., whose portrait is given in Fig. 14. Though not a native of of Birmingham, he was born not far away, at Stoke-on-Trent, in 1851, and laboured long and successfully in your midst to the great advantage of your University and your city generally.

He is a wonderful example of one who, although brought up under an ordinary Grammar School

FIG. 14—SIR OLIVER LODGE, F.R.S., Formerly Principal of the University

Education, was able finally to reach the greatest heights, not only in the world of science, but also in administrative ability on educational matters. It is not necessary in Birmingham to speak in detail of Sir Oliver's great work, which would occupy not a few paragraphs, but many pages.

In 1919 I had the pleasure of seeing him receive, at the hands of H.R.H. the Duke of Connaught, the Albert Gold Medal of the Royal Society of Arts, one of the highest honours bestowed in this country and one he so well deserved. It is perhaps not so generally known as it should be how important has been the part played by Sir Oliver Lodge in the early development of Wireless Telegraphy. The following reference, taken from a Biographical Sketch by "J. H. P.," circulated some time ago by Cornish Bros., Ltd., of Birmingham, may therefore be of interest:—

"One very remarkable experiment is now well known under the name of Lodge's Resonating experiment with the electro-magnetic waves in air discovered by Hertz in 1888, and there can be no doubt that if Hertz had not made the discovery we should very soon have learned it from Lodge. Indeed, Hertz himself says: 'Professor Oliver Lodge, in Liverpool, investigated the theory of the lightning conductor, and in connection with this carried out a series of experiments on the discharge of small condensers, which led him on to the observation of oscillations and waves in wires. Inasmuch as he entirely accepted Maxwell's views and eagerly strove to verify them, there can scarcely be any doubt that if I had not anticipated him he would also have succeeded in obtaining waves in the air, and thus also in proving the propagation with time of electric force.' Prepared by his own researches, Lodge at once recognised the immense importance of Hertz's discovery, and through him and through Fitzgerald the knowledge of it was rapidly spread in this country. It was no doubt largely due to British appreciation that the value of Hertz's work, and of the theory of Maxwell which inspired it, was recognised so soon in Germany.

"In the earliest years of investigation of electro-magnetic waves Lodge was ever to the fore, devising modes of creating and detecting the waves, investigating their properties, writing papers, giving lectures, and spreading far and wide a knowledge of the new wonder. Among his most brilliant discoveries was that of the 'coherer' for detecting the waves. With this detector he devised the first practical wireless telegraph, sending signals over a distance of several hundred yards.

"This was all pioneer work, done before Marconi took up the subject, and Marconi undoubtedly built upon the foundation which Lodge had laid.

"Whatever developments and changes may be made in the system of wireless telegraphy, there can be no doubt that Sir Oliver Lodge will always be recognised as one of the founders of the system, as a pioneer in researches upon which others have built."

Quite recently Sir Oliver was kind enough to open two new Laboratories in the Applied Science Department of our Sheffield University, when he gave one of his characteristic and instructive addresses, which was greatly appreciated. Birmingham is indeed greatly indebted to Sir Oliver Lodge for all that he has done. May he long be spared to continue his work.

Amongst other Birmingham men of note in the World of Science of to-day is Dr. F. W. Aston, F.R.S., who only last year was awarded the great and much-prized distinction of the Nobel Prize. Dr. Aston graduated as B.Sc. from Birmingham, and was on the Staff of the late Professor Poynting. Before his association with Sir J. J. Thomson, P.P.R.S., he obtained his D.Sc. in Birmingham, and his Research Fellowship at Trinity College, Cambridge.

I am glad to see that he will deliver the Hay Lecture of the Institute of Metals on "Atoms and Isotopes" before the British Empire Mining and Metallurgical Congress next year. Professor Aston's paper on "Atomic Weights and Isotopes," as given in Lectures before the Franklin Institute of Philadelphia in March, 1922, is a most fascinating one and ought to be read by all those studying or interested in Chemistry or Physics. In these Lectures Professor Aston brings before our minds probably more clearly than anyone else what is meant by the atom. I am therefore led to refer to some of his more interesting statements and to quote them freely. Concerning the atomic structure of matter, he says that matter is discontinuous and consists of discrete particles is now an accepted fact, but it is by no means obvious to the senses. The surfaces of clean liquids, even under the most powerful microscope, appear perfectly smooth, coherent and continuous. The merest trace of soluble dye will colour millions of times its volume of water. It is not surprising therefore that in the past there have arisen schools who believed that matter was quite continuous and infinitely divisible.

The upholders of this view said that if you took a piece of material—lead, for instance—and went on cutting it into smaller and smaller fragments with a sufficiently sharp knife, you could go on indefinitely. The opposing school argued that at some stage in the operations either the act of section would become impossible or the result would be lead no longer. Bacon, Descartes, Gassendi, Boyle and Hooke were all partial to the latter theory, and Newton, in 1675, tried to explain Boyle's Law on the assumption that gases were made up of mutually repulsive particles. Going on to consider the figures expressing the number of atoms in an ordinary mass of material, Aston says that the mind is staggered by their immensity. Just as an illustration, applying his method of subdivision into cubes, any vivid notion of the size of the cubes passes out of our power at about the twelfth subdivision. Thus, if we slice a decimetre cube into square plates one atom thick the area of these plates will total one and one-quarter square miles. If we cut these plates into strings of atoms spaced apart as they are in the solid, these decimetre strings put end to end will reach 6.3 million million miles, the distance light will travel in a year, a quarter of the distance to the nearest fixed star. If the atoms are spaced but one millimetre apart, the string will be three and a-half million times longer yet, spanning the whole known universe.

Again, if an ordinary evacuated electric light bulb were pierced with an aperture such that one million molecules of air entered per second, the pressure in the bulb would not rise to that of the air outside for a hundred million years. Perhaps the most striking illustration is as follows:—Take a tumbler of water and—supposing it possible—label all the molecules in it. Throw the water into the sea, or indeed anywhere you please, and after a period of time so great that all the water on the earth—in sea, lakes, rivers, and clouds—has had time to become perfectly mixed, fill your tumbler again at the nearest tap. How many of the labelled molecules are to be expected in it? The answer is roughly 2000, for although the number of tumblers full of water on the earth is 5×10^{21}, the number of molecules of water in a single tumbler is 10^{25}.

From the foregoing can be grasped the immensity of the problem with which we are faced. It would appear absurd to hope to obtain effects from single atoms; but, as Professor Aston points out, this can now be done in several ways. In fact, it is largely due to the results of experiments in this direction that the foregoing figures can be stated with so much confidence. It is not possible to go into the subject fully here, but Birmingham should indeed be proud to have one come from their midst who is helping so materially to solve a problem which, without doubt, in the not far distant future, will intimately concern the welfare of the inhabitants of this world of ours.

As further showing the practical bearing of the work upon which Professor Aston has been engaged and the clear manner in which he has been able to bring together the researches of various scientists, I quote from him once more when he says:—Take the case of one gramme atom of hydrogen; that is to say, the quantity of hydrogen in 9 c.c. of water. If this is entirely transformed into helium the energy liberated will be $.0077 \times 9 \times 10^{20} = 6.93 \times 10^{18}$ ergs. Expressed in terms of heat this is 1.66×10^{11} calories, or, in terms of work, 200,000 kilowatt-hours. We have here at last a source of energy sufficient to account for the heat of the sun. In this connection Eddington remarks that if only 10 per cent. of the total hydrogen on the sun were transformed into helium enough energy would be liberated to maintain its present radiation for a thousand million years.

Should the research worker of the future discover some means of releasing this energy in a form which could be employed, the human race will have at its command powers beyond the dreams of scientific fiction; but the remote possibility must always be considered that the energy once liberated will be completely uncontrollable and by its intense violence detonate all neighbouring substances. In this event the whole of the hydrogen on the earth might be transformed at once and the success of the experiment published to the universe at large by our emergence as a new star!

In addition to the foregoing names, reference may be made, amongst others, to Sir Gerard A. Muntz, Bart., Past President of the Institute of Metals, who has done so much to assist the Metallurgy of Non-Ferrous Metals; Sir George W. Kenrick, Chairman of the City of Birmingham Education Committee; Alderman W. A. Cadbury, J.P.; Sir Charles Hyde; Sir Hallewell Rogers; Mr. G. C. Vyle; Alderman J. H. Lloyd; Mr. F. Dudley Docker; Mr. W. Tangye; Sir Edward Manville; Mr. H. James Yates, and many others.

Reference should also be made to the most excellent work of Dr. J. Newton Friend, head of the Chemistry Department of the Municipal Technical School, Birmingham, Scientific Adviser to the Corrosion Committee of the Institution of Civil Engineers, and Examiner in Chemistry for the same Institution. Dr. Friend received, in 1913, the Carnegie Gold Medal from the Iron and Steel Institute for his researches on Corrosion, on which subject he has built up a well-deserved reputation. I wish Dr. Friend every success in the enlarged scope of his work now to be undertaken in his new Lecture Room and Research Laboratory. The latter, I understand, is to be devoted mainly to Corrosion Research.

SECTION III.—BIRMINGHAM UNIVERSITY.

Foundation and Development.—In an article on "The Birmingham University," by Professor C.

FIG. 15—MR. C. GRANT ROBERTSON, M.A., C.V.O., the Present Principal of the University

Alfred Smith, M.Sc., M.I. Mech. E., which appeared in *Engineering* in 1906, it was mentioned that the beginning of higher education in the Midlands, including both scientific and technical education, was marked by the opening of the Mason Science College at Birmingham by Huxley in 1880. This building forms part of the Chamberlain-square, which contains the Town Hall, Free Library, Art Galleries, and Municipal Council House. Also alongside is the statue of Sir Josiah Mason, one of Birmingham's great citizens, who founded the College. It was in 1898 that Mr. Joseph Chamberlain publicly announced the idea of a Birmingham or a Midland University, as some have termed it, and about the same time Mr. Andrew Carnegie forwarded a munificent donation of £50,000, accompanied by his usual practical advice that, before anything was done in Birmingham, it would be advisable for the Council to ascertain what was taking place in the United States. A special deputation was therefore sent some four years before the Moseley Educational Commission was despatched

* An address delivered before the Birmingham University Metallurgical Society on Tuesday, October 30th, 1923. Abridged.

Continued from page 512.

on its famous tour of inspection over the same ground. Dr., now Sir, Oliver Lodge was appointed Principal of the University, and amongst the Professors were Drs. Poynting, Bridge, Lapworth, also Sir William Tilden, F.R.S., who has done so much for the Science of Chemistry.

Then followed the erection, on a site of some 25 acres, of the present University, known as the new Bournbrook Building, where this Lecture is being delivered. It was largely the foresight of that great Englishman, Mr. Joseph Chamberlain, which enabled Birmingham to take up the University scheme, and later on he well said, "We have built for posterity." High as is your Chamberlain Tower—some 325ft.—surpassingly higher in the minds of his countrymen was this great Englishman himself.

Leading Men.—Amongst those controlling the affairs of the University at the present time are Lord Robert Cecil, Chancellor; Sir Gilbert Barling, Bart., C.B., Vice-Chancellor; Mr. C. Grant Robertson, M.A., C.V.O., Principal of the University, Chairman of the University Research Board; Sir William Ashley, Ph.D., M.Comm., M.A., Vice-Principal of the University and Dean of the Faculty of Commerce; Professor F. W. Burstall, M.A., Dean of the Faculty of Science; Professor F. C. Lea, Civil Engineering; Professor Thomas Turner, Metallurgy; Professor F. W. Gamble, Mason Professor of Zoology and Comparative Anatomy; Dr. G. T. Morgan, Professor of Chemistry, who holds the office previously occupied by Professor P. Frankland, F.R.S.; Professor S. W. J. Smith, Professor of Physics; Dr. G. N. Watson, Professor of Mathematics; and Mr. G. H. Morley, Secretary, to whom I am indebted for information on the subject of your University.

I do not, of course, refer to the individual work of all the eminent men forming the University, that is, outside those branches of knowledge with which I am dealing in this Address. I would, however, mention Mr. Charles Grant Robertson, C.V.O., M.A., whose portrait is shown in Fig. 15, the Principal of the University since 1920. In view of his many successes at Oxford and his historical studies, which are of the highest order, Birmingham University is to be heartily congratulated in having obtained his guidance and help. There is also the important work of Sir William Ashley, Vice-Principal and Professor of Commerce since 1901, who, whilst neither an Engineer nor a Metallurgist, has rendered great service to our country in connection with his studies of Economics, which so intimately concern Commerce and Industry. His many contributions are valued most highly; long may he continue his good work.

In this respect I call attention to the great work being done by the London School of Economics and Political Science, with its able Director, Sir William Beveridge. The true way to fight and conquer Bolshevism and Communistic heresies—for they are nothing else—is by increasing knowledge in this branch of human thought. Our British Labour Party in the main happily seems to understand this, at any rate most of their Leaders do. Such study is the true safety valve in our National Education, and in this respect I think we differ from all other Nations. It may be added that in the London School of Economics mentioned there are no less than sixty-one Professors, Readers, and Lecturers on the Staff of the School, with eighteen Tutors, Assistant Lecturers, and Assistants, and more than forty separate subjects are dealt with.

The subjects of the courses amount to more than two hundred, comprising:—

Economics.—Economics, Descriptive Economics, Economic Theory, Economic History, Economics of Russia, Economics of India.

Statistics.—Statistics, Mathematics, Mathematics and Statistics, Statistics and Library.

Commerce.—Commerce, Accountancy and Banking Methods, Transport, Shipping, Accounting, Costing, Industrial.

Geography.—Geography, Geography and Commerce, Commercial Geography.

Languages.—English, French, German.

Law.—Law, Commercial and Industrial Law, International Law, Constitutional Law, Railway Law, Mercantile Law, Industrial Law.

Sociology.—Sociology, Social Science and Administration, Social Anthropology, Welfare Work, Industrial Psychology, Ethnology, Physiology.

History.—History, French History and Institutions, History and Public Administration.

Politics.—Political Science, Politics and Public Administration, Public Administration, Public Finance, Comparative Administration.

Another member of the University is Professor F. M. Dixon, M.A., M. Inst. C.E., who has done most excellent work. The great assistance he rendered to Sir Henry Fowler, Director of Production in the Ministry of Munitions during the War, is well known and appreciated by his countrymen. Professor S. W. J. Smith, M.A., D.Sc., F.R.S., Professor of Physics, has to his credit publications and papers on Electricity and Magnetism which are highly appreciated. He is being assisted by Mr. A. A. Dee, who for several years rendered me excellent service and assistance. In June last he submitted to the Royal Society, through Professor Smith, a paper on "The Effect of Quenching from Above the Carbide Transition Temperature upon the Magnetism of Steel." The important work of Professors Burstall and Turner is referred to in the later sections of this Address. It has recently been announced that amongst the musical studies to be taken up at the University is that of bell ringing, this being due to the initiative of Professor Granville Bantock. Apparently students of Campanology have hitherto been overlooked. The subject will be included in the Acoustics Courses and lectures will be given on bells and bell music by the eminent authority, Mr. Starmer. A special collection of bells is being made for the purpose of demonstration and practice.

It will be noticed that reference is made in Section VI. of this Address to the constitution of the proposed "Museaum Minervæ" in 1636, which included a Professor of Music, who was to teach skill in singing and music, to play upon the Organ, Lute, Violl, and other instruments. In one of the departments of the Great International Exhibition at Paris in 1878 the pleasing effects obtained on quite a large scale from musical chimes still remain in my memory. The University is to be congratulated upon having taken up educational work in this direction.

In view of the researches carried out by Professor F. C. Lea, of the Department of Civil Engineering, with regard to the testing and utilisation of Metallurgical products, a brief reference may be made to some of his important work. His contributions amount to about thirty papers, many of them of important character, read before the Royal Society, the Institution of Civil Engineers, from which he received the Telford Premium, the Institution of Mechanical Engineers, the British Association, and other scientific and technical bodies. During the War he was a member of several special committees, and carried out much useful research work in connection with rigid airships, aeroplane structures, and aeroplane engines. His long experience, before coming to Birmingham, as chief assistant to Professor Unwin and Professor Dalby at the City and Guilds Engineering College, has been most valuable.

Special reference should be made to the famous 300-ton testing machine in Professor Lea's Department, indeed a giant among testing machines. It is capable of pulling a tensile test bar of 3¼in. diameter and 3ft. 6in. in length, and can also be used for compression and bending tests of beams. Owing to its large loading capacity it proved most useful during the War in connection with aircraft work. The machine, it is interesting to know, was made by Messrs. Avery, of Birmingham, who have recently completed a similar large impact machine of special design for testing Railway Couplers.

Progress.—As regards the progress of this great University, whose motto "Per ardua ad alta" is much to be admired, it may be interesting to state that last Session the students numbered 1924, of whom 439 were Matriculated students, practically the same as in the previous year. In the Faculty of Science there were 768 students, about 430 degrees being conferred in 1921–1922. These are indeed satisfactory results, in view of the difficult nature of the times.

The general endowments of the University are £849,000, the Special Endowments—Chairs, Lectureships, Scholarships, £336,000. It is pleasing to note that under the heading of "debt" is found the satisfactory word "*none.*" In 1921–1922 there was expended the sum of about £176,000, and the students' fees amounted to more than one-fourth of this total. Thus as an approximate estimate it may be stated that on your population, roughly one million, this works out at about thirty-two pence per head after making the allowance just mentioned. When all the advantages derived are considered, the investment is indeed a cheap one. Imagine for one moment all these facilities taken away—Birmingham would be left in Cimmerian Darkness. As the result mentioned represents generally the condition now prevailing in our country, we can congratulate ourselves upon the wonderful advance made during about the last thirty years. It is marvellous how we ever got on without these facilities in what may be termed those pre-educational times. I do not know what were the costs or receipts of the Metallurgical Section, but I notice that the stipends represent the modest sum of £2100, which with £1000 for the apparatus and wages represents a total of £3000.

Knowing the high quality of the work turned out by the Head of this Department, Professor T. Turner, who has toiled for some forty years on your behalf, here again it can well be said that Birmingham is to be heartily congratulated upon this section of her University work.

Number of Universities and Colleges.—Whilst referring to University work it may be interesting to mention that in my Presidential Address to the Society of British Gas Industries, under the section devoted to Education, I pointed out that in our Empire, including the British Isles, Commonwealths, Dominions and Colonies, there are 60 Universities, 233 Colleges, and 44 Technical Schools. These numbers compare with 98 Universities and 16 Technical Schools in the United States. France has 16 Universities, Italy 22 Universities, Austria-Hungary 11, and Germany possessed 21 before the War. As regards the teaching staff in the Universities, including the Heads, Professors, Lecturers, Demonstrators, and Trained Assistants, it is believed that there are not far short of 10,000 in the British Empire.

(To be continued.)

The Johore Causeway.

WHAT is known as the Johore Causeway has now been so far completed that goods trains passed over it on September 17th and the first passenger train on October 1st. We give four views of it in our Supplement.

In our issue of April 30th, 1920, we gave drawings and a brief description of this undertaking. The Causeway, which crosses the Straits of Johore linking up the Island of Singapore with the mainland, is formed on a rubble mound which is 3465ft. in length. When completed, the Causeway will be 60ft. wide at the top and will carry two lines of railway and a roadway 26ft. wide. Its construction became necessary for the following reasons. The railway across the Island of Singapore connecting the town and port with the Straits of Johore was opened for traffic in 1903. It was originally built by the Government of the Straits Settlements but was subsequently purchased by the Government of the Federated Malay States. The Johore State Railway, which was built at the cost of the State of Johore by the Federated Malay States Railway Department, and is now leased by the latter, was opened in 1909, and at the same time a wagon ferry service between the two railway termini—Johore Bahru and Woodlands—which face one another across the Straits, was brought into use, the ferry boats carrying six goods wagons at a time. While, however, goods were carried from the island to the mainland, and *vice versâ*, without transhipment, the passenger traffic was, until the opening of the Causeway, effected by means of launches. A train ferry service had been considered but, at the time, it was thought that the expense of installing it would not be justifiable.

In July, 1918, the railway system of the Federated Malay Straits was connected with that of Siam and, since the Johore State Railway joins up with the former, it then became possible to travel direct from Johore to Bangkok without change of carriage. The advantages which would accrue from filling up the gap between the Island of Singapore and the mainland so that there might be direct railway connection from Singapore town not only with the F.M.S. but also with the Capital of Siam then became more than ever evident. The question was of enhanced importance in view of the considerable growth in the goods traffic which had taken place since the wagon ferry had been instituted in 1909. In 1911 11,500 wagons were transported over the Straits. By 1917 the number had increased to 54,000—which, at six wagons a time, represents an average of more than one trip per hour continuously. The number increased to 58,402 in 1921, and it was only by working day and night that the boats were able to cope with the traffic.

Moreover, everything at that time pointed to an increase in the rubber traffic, and on the recommendation of Mr. P. A. Anthony, M. Inst. C.E., the General Manager of the F.M.S. Railways, the Government decided that something must be done to furnish increased transport facilities, and several schemes were considered. The first suggestion was that a bridge should be constructed, but it was negatived for several reasons. In the first place investigations showed that the available foundations were not satisfactory. The average depth of water on the line which the bridge would have to take is 46ft. at low tide, and in some places it is as much as 70ft. Then, again, a bridge, if constructed, would have entailed considerable expense in maintenance, and it would have had to be provided with an opening span. The first proposal to make a rubble Causeway was made by Mr. W. Eyre-Kenny, M. Inst. C.E., who was at that time Director of Public Works in the Federated Malay States, and eventually it was decided to construct a Causeway from designs prepared by Messrs. Coode, Fitzmaurice, Wilson and Mitchell, of Westminster, who were called in as Consulting Engineers. A potent factor in the decision was that a Causeway when once constructed would cost less to maintain than would a bridge.

The Causeway is being formed on a mound of stone rubble, the material for which is being quarried at Bukit Timah, in the Island of Singapore, and on the small island of Pulau Ubin, which lies some 16 miles away in the eastern entrance to the Straits of Johore. The greater portion of the mound consists of granite rubble of all sizes up to 5 tons, which was deposited exactly as it comes from the quarry. On each side of the bank commencing at 15ft. below low water of spring tides a coating 10ft. thick of heavy rubble, ranging in weight from 5 tons down to ½ ton, was deposited and finished off to a slope of 2 to 1. This coating was taken up to a height of 4ft. above L.W.O.S.T., and its upper surface was brought up to form a berm so as to provide against possible displacement of the upper portion of the work by wave action. Blocks of 6 to 1 concrete were laid at the back of the berm to form a toe for the granite rubble pitching, which was laid to a slope of 1½ to 1 on the upper slopes of the Causeway. The rubble was brought to the site in 300-ton hopper barges with opening bottoms, which were towed from the quarry by tugs and then moored in position by ropes attached to moorings. The depositing of stone in this manner was carried on from both ends, and

when the channel had been narrowed down to about 1000ft., it was found that the currents through the opening were about 5 miles per hour. Stone was then deposited all over the channel but not up to such a height as to interfere with navigation until the lock was ready for the passage of vessels. When the mound had been raised as high as was practical by deposition, short lengths, sufficient to permit of the erection of a derrick crane were built up by a floating crane. The building of the superstructure was then effected by means of the derrick crane. The maximum quantity of stone deposited in any one month was 55,000 cubic yards. The roadway consists of a bed of 9in. of granite rubble closely packed on edge with a 6in. layer of granite metalling on the top. It is calculated that when the Causeway is completed, which it will be next year, it will contain over 1¼ million cubic yards of stone.

A disadvantage of a structure of this kind is that it blocks the Straits, and special provision has to be made for the passage of craft from one side of it to the other. To get over this difficulty a lock has been formed in the mole at the Johore end. As a matter of fact, though there is deep water at the eastern end of the Straits—where, by the way, it is proposed to establish the new British Naval Base—the western end is shallow and can only be used by small vessels. It was not necessary, therefore, that the lock should be of any great size. Actually, it has been made 170ft. long between the gates by 32ft. wide at the gates, though it is widened out to 45ft. for a certain portion of its mid-length, so as to allow of a number of boats entering it at the same time. It has been furnished with a double set of gates since, owing to the tides, the flow of water changes in direction. The depth of water on the sills at low tide is 10ft. For the regulation of the water level in the lock a culvert, 5ft. high by 3ft. wide, is provided in each side wall, and water is admitted into or released from the lock by means of hand-operated cast iron sluices which are furnished with gun-metal faces. From the culverts there are five openings, 2ft. 6in. by 2ft., through each side wall. In each of the recesses into which the gates swing there are also three outlets 1ft. in diameter, which are for the purpose of flushing out deposits of silt. The lock gates are of steel. They are 24ft. in height by 20ft. long and 3ft. 6in. wide at the centre, and are divided into seven decks. The outer plates are curved to a radius of 22ft. The gates are operated by hand-worked capstans, each leaf having hinged to it a steel joist which has attached to it a cast steel rack. The lock has been open for traffic since January of this year.

With the lock cutting across the Causeway it was, of course, necessary to have some means of spanning the former, which could be taken away so as to permit of the passage of vessels. A bridge of the rolling lift type was chosen, and its construction was entrusted to Sir William Arrol and Co., Limited, of Kilmarnock. It is the first of its kind to be erected in the Straits Settlements. The moving part of the bridge weighs 570 tons, and it is operated electrically by a 35 horse-power motor, hand gear being also fitted for use in case of breakdown or failure of the electric current. It is estimated that against a fresh breeze it will take 3½ minutes to lift the bridge by power as compared with 19 minutes with four men. The structure has a clear span of 32ft. and is 57ft. wide. It is composed of three main plate girders, 38ft. long and 5ft. deep, with cross girders, spaced 7ft. apart, to which are attached the longitudinal rail bearers and the floor troughing. At the rear end of the main girders are attached segmental girders curved to a radius of 14ft. 1½in., which carry the ballast box. The latter, which extends for the full width of the bridge, measures 9ft. by 7ft. 6in. The ballast consists of concrete and pig iron. The segmental girders rest on level track girders, which are carried on beam grillages anchored into the solid concrete of the dock wall, the whole being concreted up to the level of the track girders. The length of roll of the bridge is 20ft., and the track plates have projections 6in. by 3in. by 2in. high, which engage with slots in the segmental girders to prevent any motion of the bridge except rolling motion. The power for operating the bridge is transmitted from the motor through gearing to operating pinions at the centres of the rolling segments at each side of the bridge. These pinions engage in two cast steel spur racks which are bolted to girders carried on trestles, which are, in their turn, bolted to the bridge abutments.

In order to obtain railway communication across the Straits at the earliest date possible, the making of the roadway portion of the Causeway was undertaken first. As soon as a half width bank was completed, a temporary single track was laid over which the traffic was conducted, while the remainder of the bank was being completed and the permanent rails laid. The reason for this procedure was that, if the railway portion had been constructed first, the roadway portion would have been cut off from the Pulau Ubin quarry, unless the barges carrying the stone were passed through the lock, which would have meant the wasting of a good deal of time and have caused much inconvenience.

At the moment of writing we do not know what effect, if any, the Causeway has had upon the general conditions in the Straits. The complete closing of the channel has, of course, interfered with the natural flow of the tides, and it will be interesting to see whether there will be any untoward consequences. It was anticipated, that unless precautions were taken to prevent it, there might be an accumulation of floating refuse against the Causeway at the Johore end, and therefore ten circular culverts, each 5ft. in diameter, have been formed from side to side through the structure near the lock, with their inverts at L.W.O.S.T.

It will be remembered that, in our issue of January 19th last, we mentioned that it is intended to take advantage of the construction of the Causeway to lay on the latter the pipe line which is to convey to Singapore the new water supply from the Pulai Reservation. In order to lead the pipe line past the lock a subway 11ft. 6in. wide and 8ft. high has been formed.

The contract for the whole of the works was given to Topham, Jones and Raillin, Limited, of London, and operations were begun in 1919. As the firm had recently completed extensive works in connection with Singapore Harbour, it was in a particularly favourable condition to undertake and carry out quickly such an important work as the building of the Causeway, the cost of which is, we understand, estimated at 17,000,000 dollars, or about £1,955,000. This outlay will be borne jointly by the Governments of the Federated Malay States, the Straits Settlements, and the Protected Malay State of Johore. Mr. James Brown, M. Inst. C.E., is the Chief Superintending Engineer in the Malay States on behalf of the Consulting Engineers; while Mr. D. Paterson is the Resident Engineer under Mr. Brown in actual charge of the Causeway.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE PIECEWORK SYSTEM.

SIR,—I was greatly interested in the letter of your correspondent, J. Taylor, on piecework, but I should be sorry to think that things are so black as he has painted them. It is not to be denied that the application of piecework and bonus systems leave much to be desired, but it is not so easy to equitably apply them as so many writers would suggest; so much depends on the management, as well as those in minor authority, and the spirit in which it is carried out by them and the employees.

Twenty years ago, while employed by a certain firm, the bonus system was introduced for the first time, where previously daywork had been the rule. The men were up in arms against it and a strike was narrowly averted. However, they thought better of it, and it was given a trial, with the result that in a very short time almost everyone was satisfied, the only dissatisfied man being the engine driver, who was obliged to keep a full head of steam right up to "bell ho!" instead of easing down ten minutes before as he had been accustomed to do. It was made a rule that time given for a job should on no account be lowered, however disproportionate it might be; on the other hand, times could be, and frequently were, raised if the time allowance was too short. The times were never given by the foreman, though his advice might be taken; consequently, there was not much room for favouritism. Great stress was laid on the importance of a high weekly bonus total by the management, and certain individuals had a sorry time of it if it fell below a certain percentage. The system, while I was there, worked well, and no one would have cared to go back to the old way.

Another experience of mine was with a very large firm where the monthly piecework balance was in vogue, and had been for many years—so long, in fact, that many men had not bothered about getting their hourly rate raised. They got so much for the job and drew the balance at the end of the month, so it made no difference to them in the long run, and it was only as newer methods were introduced that they did so. Here the methods employed in fixing piecework prices were, in the case machine work, to have the job first done by a reliable man who was in a small department not on piecework. He was paid above the ordinary day rate, and his time and a certain percentage added formed the basis for the piecework rate. In most other cases the jobs were usually given as daywork in the first instance to the man who would eventually do that particular job piecework. Here again the rule was that men should be allowed to make all they could. Unfortunately, the men in one department could never be convinced of this, owing to their foreman slating them if their balance exceeded a certain percentage; because the piecework rate was built up partly on that percentage. The consequence was that when a man thought he was going over the mark he either went slow, consequently decreasing his output, or he would return work to stores without putting in a piecework claim. This was quite unauthorised, and had a very bad effect, and neutralised to a certain extent the output of the shop. The punishment in this works for men was to put them on daywork.

Again, another firm used the bonus system, and in this case, it being a trade union shop, the times were very generous. All the bonus times were known at the local branch, and members were forbidden to go below a certain minimum. One man did so, was promptly reported to and fined by the union. As an example, the time allowed for a certain job was 110 hours; the time booked was always 60 hours, this being the trade union minimum. Some time after the outbreak of war, the embargo was raised. The time taken to do the job fell to 30 hours—110 hours to do a 30-hour job needs no comment. A fettler in the foundry was allowed so much per hundredweight for small castings. Crank cases which had been daywork were given to him as piecework. These were extended at the same rate. His earnings thus came to £6 or £7 per week, and he was in the habit of losing eight or ten hours per week. When it was realised after some weeks that a mistake had been made, it was decided that it was too late to make any alteration. Needless to say, this firm went bankrupt after the war.

The worst case of payment by results that I know of is that of a firm that I worked for last year, where cheap labour is largely employed. In this case the prices were so low that many of the employees could not earn a full week's wage, and were heavily in debt. Every agreement arrived at by the trade unions and the employers' federation was evaded or ignored. The idea seemed to be to fix such a price that an exceptional operator could just make it pay. The consequence was that the knowing ones would bluff the rate fixer and book their time to suit the prices—less time on a low-price job, more time on a high price.

In my opinion, payment by results is a very good thing if properly applied, and if the methods used are not too complicated and do not need a slide rule to calculate the earnings. It is, of course, assumed that there is plenty of work to be done. It is useless to expect output in a shop that is short of work, neither is it much use to give a man piecework who also does a great deal of daywork; he will usually see to it that his jobs pay.

It is my experience that men do not object to payment by results, but it has been so abominably mismanaged by different firms—some wanting to skin the employees and others laying themselves out to be swindled—that it has not had fair play; nor do I think that British mechanics are less industrious or capable than those in other countries. There is a great deal too much made out of "clock watching" and "going slow." I myself have been a clock watcher and gone slow in shops where the foreman has sometimes been unable to give you a job to follow on with—perhaps forgotten you—and when later on you remind him he would tell you to "hang on to the job you have," and probably if you ask him again, he very forcibly tells you to wait till he comes to you; and if you are wise, you will shut up, especially if there is a shortage of work and hands are being discharged. So you try to look busy with a job that is finished and pass the time away. A friend of mine is in charge of about 100 girls. They are sometimes held up a whole day waiting for parts to assemble. The complaint usually made to him is not that they are doing nothing, but that he allows them to stand about in groups and talk.

I believe that a great deal could be done to improve trade if firms were always efficiently managed, or perhaps it would be better to say, sensibly managed; always bearing in mind that a slack shop is an inefficient shop, a busy shop is a happy shop, and that a driven shop is H—ll.

November 8th. VECTIS.

THE FUTURE OF ENGINEERING.

SIR,—In your issue of the 9th inst. you raise the question of what the future holds for the engineering profession. In the same number you also call attention to the fact that the development of the engineer's art has left the inventor bankrupt of revolutionary ideas, at least so far as recent progress in invention goes to prove. This last fact is a subtle commentary upon, if not a complete answer to, the first question, for the callings of the inventor and the engineer, though not necessarily synonymous or even usually so, are undoubtedly the complement of each other, and bankruptcy in the one spells the approaching *ultima thule* attainable by the other. The same doubts that may beset us in these professions are no less absent in the other professions also, and the future of the engineer is clearly bound up in the future of Empire and of civilisation itself, for he has been chiefly responsible for the development of both. What, then, is the position to-day? If we take our heads out of the sand and cease to listen to the dangerous meanderings of that well-meaning but futile body, the League of Nations, and other pacific institutions of the same order, we can clearly see the whole of the so-called civilised world seething with discontent, and subconciously it may be, forming itself into "sides"—"picking-up," in the school-boy phrase—for such a war as will make the Great War an affair of outposts, comparatively speaking, and though this idea is horrifying in its potential dreadfulness, it is useless to deny its existence. We are, in short, too thick on that part of the globe that offers us normally easy existence, and with disrupted trade between nations, we are living in each country by the economic fallacy of "taking in each other's washing," nor is the spirit of enterprise seemingly sufficiently alive to drive our young men forth to wrest new lands from virgin forest and prairie, and so to provide work for the professions for which your journal caters, and which would possibly solve our present difficulties for a further period, for the cultivator must ever go first, or at least "show willing" to accompany the engineer, whose bridge building, railway laying and water supply works are necessary to obtain the amenities of civilisation to which this age has become accustomed. That, terrible as it is, can be the only answer to the question you raise. Each civilisation defeats its own ends by its own development, and the present one, thanks to the advent of mechanical power and electricity, has arrived at its zenith here in the West in the short space of some 150 years. In the East the period is even shorter, and Japan may be said to have attained a very creditable veneer of civilisation in half that period. Such mushroom growths, when viewed down the ages, must inevitably perish as they arose, or is this generation sufficiently foolish to arrogate to itself an immunity from the fate of all its predecessors since man began to compile history, whether for religious or lay purposes? The engineer may, however, take heart of grace, for in either event—expansion or Armageddon—he will be wanted, and badly so.

November 12th. WELL SINKER.

PRESENTATION TO MR. J. H. NARBETH.—Mr. J. H. Narbeth, who recently retired from the post of Assistant Director of Naval Construction, was the guest of honour at a luncheon given by the Royal Corps of Naval Constructors at the Criterion Restaurant, Piccadilly-circus, on Wednesday, October 24th. The gathering, which numbered forty-four, was presided over by Sir Eustace H. Tennyson d'Eyncourt, K.C.B., Director of Naval Construction, who was supported by the senior officers of the Royal Corps. Sir Eustace, in proposing the toast of the guest, remarked that it was unnecessary for him to remind his audience of Mr. Narbeth's services; they all knew what a great naval architect he was, and they all knew of his achievements and the manner in which he had always worked to maintain and improve the prestige of the Royal Corps of Naval Constructors. In conclusion, he asked Mr. Narbeth to accept a silver salver as a token of the esteem in which he had always been held by the Royal Corps, who wished him long life and prosperity in his retirement. Mr. Narbeth, in replying, thanked Sir Eustace d'Eyncourt for the kind reference to his past services, and said how much he appreciated the honour paid to him by such a representative gathering of the Royal Corps. He was gratified, he added, to be able to say that the Royal Corps worked as a team and that harmonious relations existed throughout all ranks.

HAND-OPERATED TABLE FOR PUNCHING MACHINES

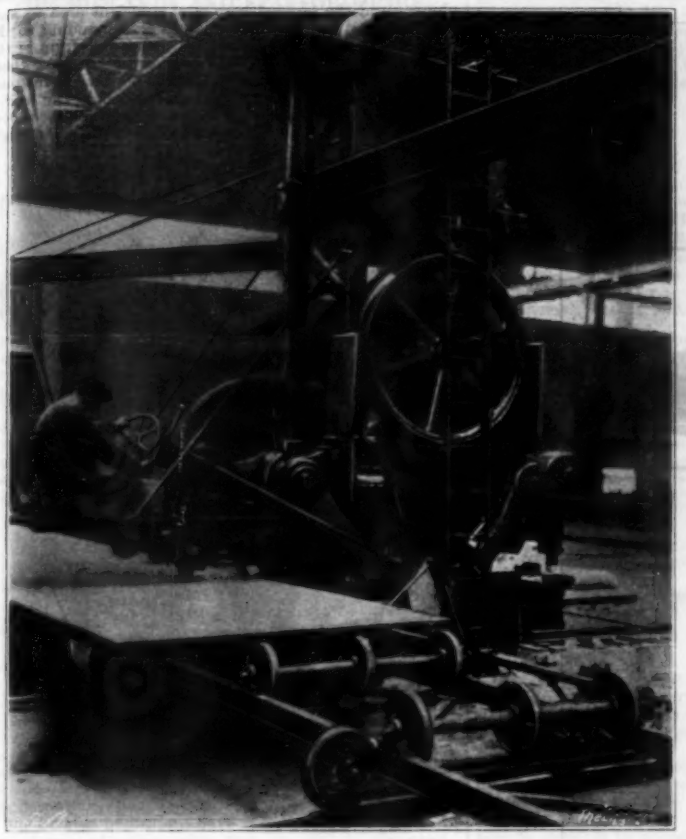


FIG. 1

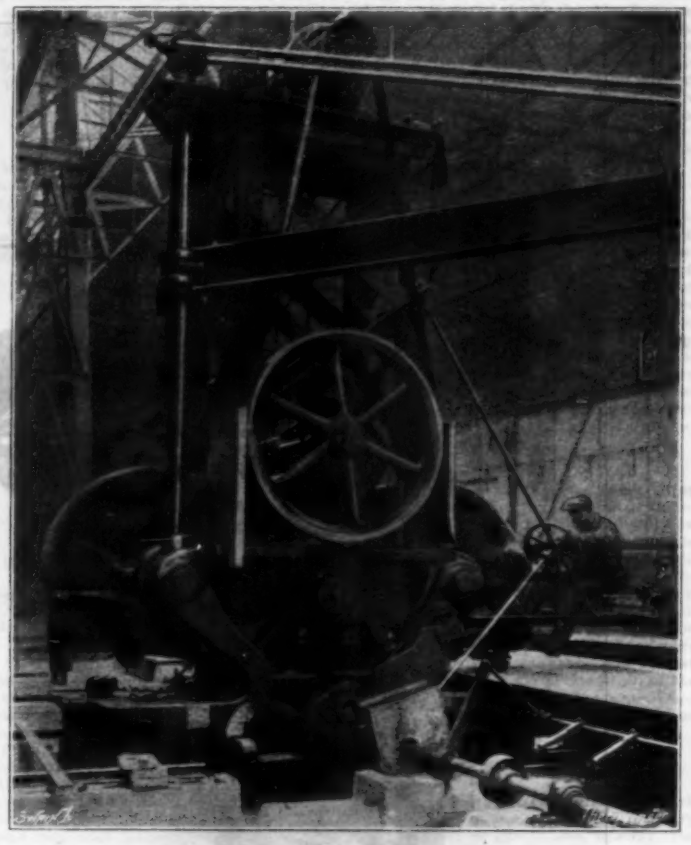


FIG. 2

A One-man Punching Table.

THE one-man punching machine, both in its full and semi-automatic form, has for long been a conspicuous feature in continental shipbuilding practice, and the machine itself has been developed to a high state of perfection by the German firms of Sack and Schiess. This type of machine tool has not, however, enjoyed any wide use in British yards, doubtless on account of its relatively high first cost and the necessity of keeping it fully employed if an adequate return on capital outlay is to be realised. A new British type of punching table which, it is claimed, possesses all the advantages of the one-man punching machine, and, further, is capable of being adapted to any existing punch, has recently been placed on the market. A short time ago we had the pleasure of examining the first application of the new principle as employed on a standard double punch—see Figs. 1 and 2—which is installed in the shops of the Rotterdam Dry Dock Company. Some account of the construction of this table, its performance and the possibilities of its development, may be of interest to our readers.

The drawing we reproduce in Fig. 3 shows in plan and elevation the arrangement of the table. It consists essentially of two steel frames, one on each side of the head, which carry triple rollers upon which the plate to be punched rests. The two frames are joined together and are mounted on wheels which run on transverse rails, so that the whole framework can be moved in the direction of the breadth of the plate. The longitudinal motion is derived from six sets of live rollers connected together with chains and sprockets, and controlled through bevel gearing by a hand wheel placed to the right of the operator. The hand wheel on the left operates a worm and wheel by means of which a semi-rotary motion is given to a balanced weigh shaft running at the back of the machine and shown to the right of Fig. 2. The shaft is connected by links and levers to the carriage of the table, and moves it in a breadthwise direction. The chief feature of the machine is the position of the operator, who is seated directly in front of the punch head and over the plate. In this position he is able to observe accurately the relative position of the punch and the marks on the plate, and by controlling the two hand wheels to register the punch in the exact desired position. A foot trip is provided to throw the punch in and out of action. Fig. 1 shows the operator's position, and also the rollers for the longitudinal motion and the wheels for the transverse motion. When we saw the machine working, a shell plate 30ft. long by about 7ft. wide by ¾in. thick was on it, and speeds of nineteen holes per minute were demonstrated with hardly a miss of the stroke of the machine. We were impressed by the sensitiveness and accuracy of control, and the comparative ease with which plates weighing up to 2 tons were moved by the hands of one man only without the aid of mechanical or electrical driving power. This accuracy and lightness of touch is achieved by fitting all the rollers, traversing wheels and shafts with ball bearings, while local friction-less support is provided near the punch by a column with a ball fitting at the top. For lining up plates on the machine, stops are provided which may be set in position and moved clear by hand levers placed to the right and left at the front of the table carriage. These stops are shown in Fig. 2 to the right of the illustration.

The table we have described may be designed for punching machines of any size or output, and for any class of work, but the appliance is chiefly intended for shipyard use. It certainly has proved very advantageous at the yard of the Rotterdam Dry Dock Company, where, after a few months' experience with one table, a second has been installed, it being found that with a double punch this equipment has an output equal to three punches without tables. A third table is now being put in. The gear for operating the movement of the table in and out of the punching machine gap has been designed and developed by Mr. D. C. Endert, jun., and the table is covered by patents jointly held by Mr. D. C. Endert, jun., director of the Rotterdam Dry Dock Company, and Mr. H. W. Curchin, of Curchin and Watson, naval architects and engineers, of 1, Seething-lane, London, E.C. 3, who are prepared to advise on its application.

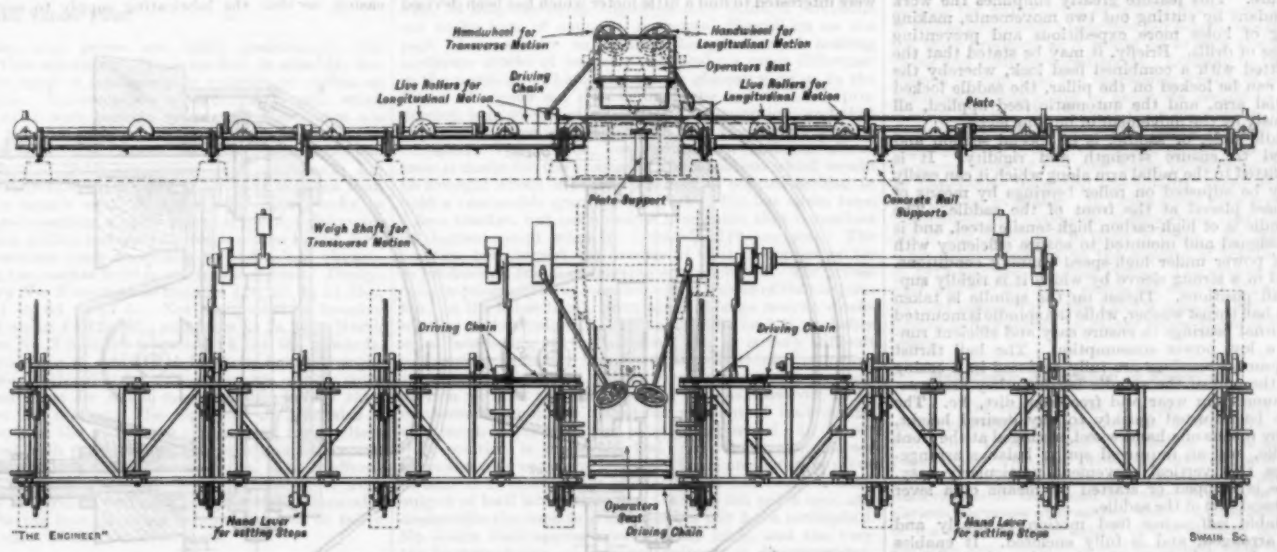
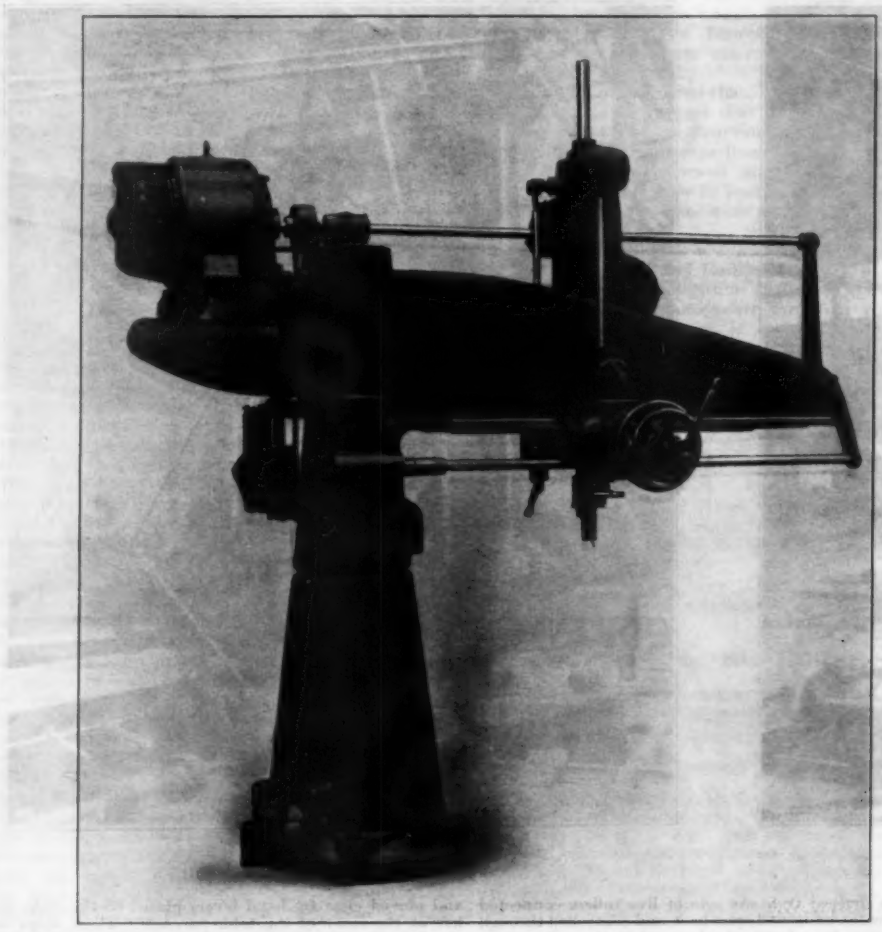


FIG. 3—ELEVATION AND PLAN OF ENDERT AND CURCHIN PUNCHING TABLE

THAT natural-gas petrol can be used to advantage as a refrigerant is suggested by the fact that the "make" tanks and other parts of the equipment of petrol plants frequently become coated with frost. Experiments recently conducted by the American Bureau of Mines confirm this assumption and indicate that volatile petrol can be used to advantage in many refrigerating plants.

RADIAL MACHINE FOR DRILLING PLATES AND GIRDERS.

WILLIAM ASQUITH (1920), LIMITED, HALIFAX, ENGINEERS.



Radial Machine for Drilling Plates and Girders.

THE machine, of which we give an illustration on this page, has been designed and constructed by William Asquith (1920), Limited, Halifax, specially for drilling holes in plates and girders. At first sight it would appear to be of the makers' standard design, and in many respects such is the case. On looking closer into the machine, however, it will be seen that the spindle slide embraces a new feature. This feature greatly simplifies the work of the attendant by cutting out two movements, making the drilling of holes more expeditious and preventing the breakage of drills. Briefly, it may be stated that the saddle is fitted with a combined feed lock, whereby the radial arm can be locked on the pillar, the saddle locked on the radial arm, and the automatic feed applied, all simultaneously by the movement of but one lever.

The spindle slide, or saddle, is of special section and proportioned to ensure strength and rigidity. It is accurately fitted to the radial arm along which it can easily and quickly be adjusted on roller bearings by means of a hand wheel placed at the front of the saddle. The drilling spindle is of high-carbon high-tensile steel, and is specially designed and mounted to ensure efficiency with economy of power under high-speed running conditions. It is carried in a strong sleeve by which it is rigidly supported in all positions. Thrust on the spindle is taken by a double-ball thrust washer, while the spindle is mounted in roller journal bearings to ensure easy and efficient running with a low power consumption. The ball thrust and roller journal bearings are fully enclosed in a casing formed by the end of the spindle barrel; they are practically immune from wear and free from dirt, &c. The spindle can be adjusted quickly to any desired height, vertically, by means of a hand wheel, arranged at the front of the saddle, and an improved spring balance arrangement makes this vertical movement particularly easy. The spindle is stopped or started by means of a lever on the left-hand side of the saddle.

The variable self-acting feed motion is neatly and compactly arranged, and is fully enclosed. It enables variation to be made instantly through a feed change lever when more than one feed is embodied. The radial arm upon which the spindle slide travels is of improved form and strong construction, and is so arranged as to eliminate twisting stresses. The portion of the arm in which the spindle works is of box-girder section, and the walls are well ribbed. The drilling spindle works midway between the walls so as to ensure a central thrust. Thus, power consumption and drill breakages are reduced, and accurate work is rendered possible on deep hole drilling as a result of the absence of binding at the drill. The portion of the arm bearing on the internal pillar is of great length in order to give rigidity under heavy duty. The arm can be easily and quickly revolved by hand on a patented arrangement of ball and roller bearings. The standard or internal pillar carrying the radial arm is of strong section, and is well ribbed internally to ensure rigidity and to reduce the end lift of the arm to a minimum. The bottom of the pillar is arranged for bolting to a concrete or ashlar foundation, or to a base plate if desired.

A Small Flow Meter.

DURING a recent visit to the Colchester works of the Britannia Lathe and Oil Engine Company, Limited, we were interested to find a little meter which has been devised with the object of measuring very small flows of liquids, such as the supply of lubricating oil to bearings, or the petrol consumed by a motor car engine.

The meter, of which we give line drawings and a half-tone engraving, is extremely simple in construction, and it is surprising that the idea has not been developed before.

The principle on which it acts is the difference in pressure which must exist in a liquid to make it flow along a passage. This difference is balanced against a weight, and the position of the weight is a measure of the rate of flow.

Referring to the line drawing—Fig. 1—it will be seen that the oil, for instance, is made to flow upwards through the instrument. The barrel up which it passes has a tapered bore, which is ground out very accurately. Inside the barrel, and, riding freely on a fixed spindle, there is a cylindrical plunger. When the oil begins to flow it raises the plunger until the annular space between the plunger and the tapered bore is of sufficient area to pass the oil with a reduction in pressure corresponding to the weight of the plunger. There is a definite position of the plunger for every rate of flow. In order to make these positions visible the plunger is made a permanent magnet, and an H-shaped armature is mounted behind the barrel. The spindle of this armature carries a pointer that moves over a graduated scale, as shown in Fig. 3. In some cases,

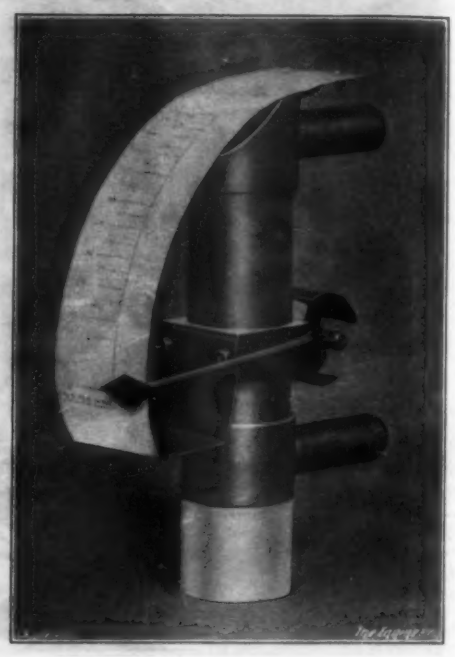
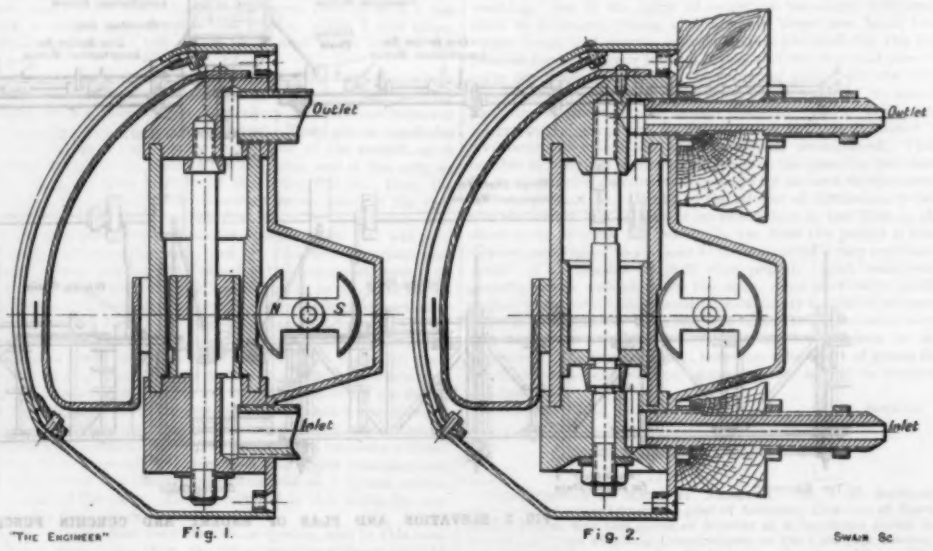


FIG. 3—BRITANNIA FLOW METER

when, for instance, the flow is exceptionally small, the arrangement shown in Fig. 2 is adopted. The only difference, it will be noticed, is that the bore of the barrel is made parallel and the spindle is tapered, so that the variable orifice is in the centre of the plunger instead of round its circumference. In either case the parts of the instrument are held together by a single nut on the end of the central spindle.

It is surprising how sensitive and dead-beat these meters are, and we tried one with the flow throttled down until only two or three drops were passing a minute. The pointer still gave a definite reading, and responded immediately and definitely to an increase in the flow. It is, of course, only a matter of calibrating the instrument to get a quantitative reading on the scale.

The makers have elaborated this little meter in several ways, one of which is to group a number of units in one casing, so that the lubricating supply to several points can be measured by one apparatus, and it appears to us that it should prove of considerable utility on motor cars and internal combustion engines.



FIGS. 1 AND 2—SECTIONS THROUGH BRITANNIA FLOW METERS

UNDER high oxygen pressures, iron and steel burn very readily and completely, and if once ignited propagate a flame with almost explosive velocity. On the other hand, brass and copper appear to burn only very slightly, usually melting off and dropping in small metallic globules.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Position.

THE tone of the Midland iron and steel market continues firm and prices are gradually moving upward as demand increases. In the steel department definite advances have this week been made, and others are expected. Inquiries are quite numerous in most branches of the market, and if buyers are not exactly persistent, there is a more healthy feeling abroad and a better disposition in the direction of stability. The expanded demands which were made on blast-furnacemen a short while ago have been steadily maintained, though the volume of business does not appear to increase. Finished ironmasters in Staffordshire continue to do slightly improved business, especially in best-class bars. Steel masters report a tendency on the part of consumers to contract forward. They are actuated no doubt by the hope of improved business from the shipyards and railways. The big enterprises which the home railway companies are taking in hand will doubtless do something to assist the industries of this district; but up to the present those Midland industries which rely upon railway work are receiving support mainly from railway developments overseas and from private traders in this country. The General Election prospects are being freely discussed in Birmingham industrial circles this week, and on 'Change to-day—Thursday—business took only a secondary place to this important national development.

Steel Values Advancing.

Steel masters this week advanced their quotations for sections 5s. per ton. It has been found possible, however, to negotiate supplies at 2s. 6d. above the rates previously ruling. For some weeks now there has been a notable improvement in the demand for structural material and values have been firming up. The new price for angles becomes £9 12s. 6d. to £9 15s., for tees £10 12s. 6d. to £10 15s., and for joists £9 12s. 6d. to £9 15s. Billets are also dearer, the general quotation for mild steel billets now being £8 5s. It is possible in one or two quarters to buy at £8 2s. 6d., but this is the absolute minimum. Indeed, the Welsh makers who are cultivating this market are not prepared to consider billet offers under £8 10s. A few Belgian quotations have reappeared, and in view of the advance of native prices they are slightly advantageous, but there is very little foreign business being done. The stiffening of billet prices and the endeavours being made to control selling values have had their effect upon the price of small steel bars, which have risen to £10 and up to £10 10s. Renewed efforts are being made to revive the Steel Bar Association, and a further meeting of those concerned has been held in Birmingham. Although some firms, and particularly re-rollers, do not regard price agreements favourably, the promoters of the effort are said to be fairly confident of success.

Scrap.

Values of steel scrap have further improved this week, most sellers asking £4 7s. 6d. per ton, or an advance of half-a-crown on last week's quotation. For prompt supplies quotations are higher. Business is brisk and some of the scrap in hand is being held in expectation of still higher prices.

Raw Iron Values Firm.

Raw iron prices are fairly maintained, but without further advances. Inquiries flow in steadily, but there are no signs of stringency in supplies to stiffen up prices further. Consumption of material is still small when compared with normal times and consumers are disinclined to take heavy deliveries, especially in the Staffordshire iron trade, where the new business booked is rather light. Both consumers and merchants are decidedly less indifferent regarding forward supplies than they were a month ago. Smelters who have stocks to dispose of are accepting a lower price for prompt deliveries than they are willing to entertain for business in the New Year. Quotations vary according to individual circumstances, but the market level is much as last week. Derbyshire foundry No. 3 commands from £4 12s. 6d. to £4 15s., and forge £4 4s. 6d. to £4 6s. Northamptonshire foundry pig is round about £4 12s. 6d., and forge £4 2s. 6d. North Staffordshire No. 3 foundry is quoted £4 13s. 6d. upwards. There are no signs of additional furnaces being brought into operation in this district. Blast-furnace owners state that demand must be much more reliable before they can consider the matter. The high cost of coke also is a real obstacle to the re-lighting of furnaces, for smelters maintain that with productions costs as high as they are, present selling values are unremunerative. The Staffordshire forges are calling for only a small quantity of iron, but foundry material is finding a better outlet. Generally speaking, the pig iron situation is considered to be fairly healthy in view of the circumstances.

Finished Iron Improvement.

The slight improvement in the Staffordshire finished iron trade is maintained, demand having improved sufficiently to enable some favourably placed makers of Crown bars to put their prices on the recognised price level. For some time prices of medium and low-grade bars have been cut much below the recognised market quotations, and manufacturers have taken the earliest opportunity to make more effective in actual transactions the recognised prices. Crown bars are now quoted £12 to £12 10s. Marked bars are in steady request at £14 10s., and the mills are running fairly evenly on full time. Nut and bolt manufacturers are showing a disposition to buy bars in a modest way ahead of their actual requirements. It is stated on some hands that the buying is more in the nature of a precautionary measure. This is rather borne out by the fact that the nut and bolt works do not seem to have received an influx of orders sufficient to account for the increased demand for bars. Great hopes, however, are based on the expected improvement in structural work and an early revival of activity in the shipyards, which would release good orders for the nut and bolt industry. Staffordshire ironmasters are endeavouring to get £10 15s. for nut and bolt bars, but they accept in many instances £10 12s. 6d. for good orders. Belgian bar iron is slightly easier at £8 15s., but continental shippers do not appear to be obtaining much business. Wrought iron gas tube strip is in poor demand at £12 10s. per ton.

Galvanised Sheets.

The galvanised sheet trade continues active, and in some cases firms have sufficient orders on their books to keep them busy until March. Most of the business is done on the basis of £19 f.o.b. for export and at works for the home trade. Premiums up to 5s. per ton are asked for early delivery. Black sheet mills are moderately employed.

Unemployment Position.

The Midland unemployment position remains in a comparatively satisfactory state. Decreases in the numbers have been recorded for several successive weeks, the most recent returns showing a fall of 3854. There is a decrease in every area, with the exception of Leamington, Dudley and Cradley. The total now stands at 160,667, of which 116,793 are men, 3291 boys, 35,928 women, and 4842 girls. In the Birmingham area the total stands at 41,292, as against the previous week's return of 41,934.

LANCASHIRE.

(From our own Correspondents.

MANCHESTER, Thursday.

General Conditions.

THERE is a general improvement to be noted this week in almost all departments of the markets for iron, steel, and metals, and an increased disposition to do business. Whether this will persist, in spite of the disturbance which must necessarily result from the effects of an approaching General Election, remains to be seen; but it is something to the good that the threat of so serious a disturbance has not yet thrown the markets back into lethargy. It seems a pity that the energy which should now be devoted to commercial and industrial matters is to be largely dissipated in political affairs; but in spite of this one may probably anticipate a much larger expenditure on iron, steel, and metals than seemed to be at all probable a few months ago. The allocation of large sums for railway renewals in the way of locomotives and wagons should afford a good deal of work for the iron, steel, and metal trades during the next six months.

Metals.

Another upward movement in copper has begun, and the point of interest is whether this is a real and permanent improvement, or whether, like so many of its predecessors, it is doomed to failure. During the last year we have seen several of these movements begin, only to lead very soon to disappointment; but, of course, in the end there will be a real rise in copper, and it may now be beginning. In this district there has been rather more disposition to buy, and it may be that just as ironfounders have thought it wise to re-establish their stocks of foundry iron, so manufacturing engineers may think it advisable not to be bare of copper. A general disposition on the part of consumers to resume the practice of holding moderate stocks of copper would make a great difference in the position. Those who take a gloomy view as to the future of copper are relying upon the fact that the production is in excess of the present consumption, and that in America there is no indication that the output is to be curtailed. This is true, but perhaps not sufficient allowance is made for the change in the situation which would be brought about if every consumer of copper decided to hold a reasonable quantity of stock. Tin has again been a firm market, but some people here think that it reached its highest point when it touched £216 per ton. The position here is just the reverse of that in copper so far as production and consumption are concerned. The actual consumption of tin is considerably in excess of the output; but, on the other hand, there are still large reserve stocks waiting to be realised. The position in lead is probably more interesting at the moment, and it is very difficult to form any opinion. Merchants usually think that prices are dangerously high, and so they appear to be in comparison with all the other metals. It has, however, to be remembered that the statistical position of lead is also very much better than that of any other metal. In copper that position is distinctly bad; in tin it is moderate when the reserve stocks are taken into consideration; but in lead it is remarkably good. There has been a lesser output of lead lately than was the case ten years ago, and meanwhile the uses to which lead is put have multiplied. No doubt lead appears dangerously high, and the very big backwardation on forward delivery is disconcerting; but one is not quite sure that prices must fall. Spelter has been a fairly steady market with no particular feature. It is rather strange to see the price quoted on a level with that for English lead.

Pig Iron.

The market in Manchester for foundry iron is scarcely quite so active as it was; but one must remember that a very large quantity in the aggregate has been bought by Lancashire ironfounders during the last four weeks, and that this iron has been bought mainly for stock and not as a direct result of a demand for castings. That the buying of castings from ironfounders will result is no doubt very generally expected, and there are some reasons no doubt why the orders for castings should soon arrive in larger numbers. The renewals of railway rolling stock will help this movement, and the re-starting of work in the shipyards will also be an assistance; but so far more pig iron has been bought than there is any present need for, and it is natural that there should be a lull. Sellers of foundry iron here are very firm and there is no indication of any falling away of prices; although if the lull in buying should last very long it is, of course, possible that there may be some weakness. Some of the Derbyshire furnaces have, however, taken orders for three and six months ahead, and it is said that contracts for delivery of pig iron over a whole year have been offered to ironmasters. It is generally understood that a small premium on current prices would have to be paid for distant delivery. There has been a little better inquiry for Scotch foundry iron of late, but the high price—say, £6 per ton delivered in Manchester—militates against any large employment of this class of foundry material.

Finished Material.

The hope of better business in the near future is sustaining the market for manufactured steel, but merchants here do not find any serious increase in the demand. Steel may, however, be reckoned as from 5s. to 10s. per ton dearer than it was a fortnight ago. The lowest price now mentioned here for joists or large angle steel is £9 10s. per ton, but £9 15s. is quite a common quotation. Some merchants have been able to secure steel plates at £9 15s. in the past, and now probably £10 5s. would have to be paid. The demand for steel plates is, of course, waiting to be stimulated by a return to work in the shipyards.

Scrap.

The condition of the market for steel scrap certainly suggests that the steel works, or some of them, at any rate, are busier than they were. Sheffield will now pay 85s. for heavy melting scrap, and in Wales up to 92s. 6d. per ton is spoken of. Lancashire scrap is handicapped by the high carriage to Wales, and has now to be sold mostly to Sheffield. Heavy wrought scrap iron is firm at 90s. to 95s. per ton delivered at the malleable ironworks, and the better demand for it suggests that the iron manufacturers of Lancashire are not so badly off for work as they were. Foundry scrap remains rather slow of sale, but it is firmer than it was. The general condition of the foundry scrap market suggests that up to the present not very much more actual work has reached the Lancashire ironfounder.

The Engineering Industry.

During the prolonged spell of depression which has pervaded many branches of the engineering industry two sections have stood out as exceptions, namely, the electrical and the textile sections. Fortunately, there is no ground for fear of any immediate falling away in the electrical trades in this district, at any rate. Speaking with reference to the future of the British electrical industry at a meeting of the North-Western Centre of the Institution of Electrical Engineers, held last week, Mr. G. A. Juhlin, the new chairman, said that while the progress in respect of the volume of electrical plant in this country was behind others, the quality, in his opinion, was second to none. He thought this was reflected in the excellent results in regard to continuity of supply from our generating stations. While in this country we were in many respects behind the United States in electrical developments, the leeway was gradually being reduced, and he felt convinced that, given a fair field, our electrical industry, whether in manufacturing or in generation of power, would meet any demands put upon it. With regard to the textile branch of engineering, Mr. F. Nasmith, speaking at a meeting on Saturday last of the British Association of Managers of Textile Works on foreign competition, said that to argue against the exportation of textile machinery was absurd. It was as impossible to prevent our machinists from exporting their products as it would be to stop the shipment of yarns and manufactured goods. Looking to the future, it seemed to him that the increasing wealth of any country industrially was going to assist its people to buy better quality goods. He thought their markets in India would tend in that direction. The influx of new machinery, together with protective duties, meant that India would consume more of her own home production, but so long as Lancashire improved the quality there would always be a market available. In China there were great areas yet untouched, and extension of exports in that direction was one of the difficulties in front of them. Mr. Nasmith gave some figures relating to the exports of textile machinery in 1913 and the last four years. The export for 1913, he said, was 178,074 tons, compared with 63,314 tons in 1920, 157,044 tons in 1921, and 155,156 tons in 1922. This year's figures will probably be rather below those of the last two years.

Manchester Association of Engineers.

On the 9th inst. a paper was read before the above-mentioned Society by Mr. J. R. Birch, A.M. Inst. C.E., on "The Crushing of Materials." The author in his paper dealt with the principles involved and their best practical application in the crushing or reduction of materials from the broad engineering point of view. The various purposes of crushing, the characteristics and sizes of material, and the nature of the stresses on individual particles were considered and explained. For coarse work, the author said, the jaw crusher, in which the motion of the jaws is produced by excentrics or toggle joints, was the most common. For medium crushing rolls, corrugated, toothed or fitted with knives, were usually employed. For wet crushing the most useful types of machine are edge runner and end runner mills. Stamps producing combined crushing and attrition are chiefly used in mining operations and are only suitable when the use of water is permissible and for medium classes of material. In many industries, it was explained, it was necessary to reduce materials of a tough fibrous nature with as little pulverising as possible, as, for example, the milling of wheat, where the husks have to be separated from the inside portions before the latter are reduced to flour. Such processes are best carried out by passing the material between grooved rolls running at different speeds. The author described in some detail the principles and construction of roller flour mills. He then passed on to describe disintegrators, disc mills, ball mills, and attrition mills.

Finally he referred to the "colloidal" mill invented by Professor A. M. Low, in which crushing and attrition forces are combined with the use of hydraulic pressure, making it possible to smash up the particles to a degree of fineness quite unattainable by other means.

BARROW-IN-FURNESS, Thursday.

Hematite.

Trade generally is better, and there are signs about of a steady improvement. One of the most convincing is the reduction of stocks held by makers; in fact, one or two ironworks have practically cleared the stocks they held. Another sign is the rise in prices, which was bound to come with a better market. By the end of the year it is more than likely that more furnaces will have been put in blast. The improvement is mostly on home account, the requirements by users having increased. The Midlands bid fair to improve with their orders, and now that more confidence prevails and that prices have an upward tendency there will be more inclination to book forward deliveries. The continental trade is only moderate, and that with America is nothing to speak of; but there are possibilities in the latter trade. Scotland is taking more pig iron and its demands will increase if the long-drawn-out boilermakers' dispute is only settled. Business in special qualities of iron is improving and likely to in the future, as the demand for this class of iron is sure to be greater in view of more engineering activity. The charcoal furnace is employed and orders are being regularly received for this special brand of iron. Business with Wales is about the same, with a more hopeful outlook.

Iron Ore.

There is a better feeling in the iron ore trade, and as soon as more furnaces are put into blast business will increase. There is not much leaving the district, nor is there likely to be for some time. Importations of foreign ore are not great, as stocks still exist at West Coast ports.

Steel.

There is a better tone in the steel trade and the requirements of British railways are likely to cause orders to be placed. Orders on railway account for England are already held, but more business will be forthcoming shortly. The Workington rail mills are experiencing better trade and the Barrow mills are at work. The hoop and section mills at Barrow are active. Founders are only fairly circumstanced.

SHEFFIELD.

(From our own Correspondent.)

Signs of Improvement.

THE feeling of confidence in the revival of the steel trade is growing, and now has a basis much more definite than that of mere hope. All the makers of railway material are looking forward to the placing of large orders under the programmes recently announced by the different groups, and several good bookings have been received during the past week, although it is hardly likely that the bulk of work will come forward until the New Year. The bar iron works, although not by any means well employed, are busier than they have been for several years. Some very satisfactory orders for wire rods have been booked. Makers of crude and finished steel have also been receiving orders rather more freely since the present month opened. Prices of scrap iron are stronger, and pig iron quotations are 2s. 6d. to 3s. 6d. higher than they were a month ago. Trade is still a long way from the normal, however. A large quantity of plant remains idle, and the shortage of work is serious. The number of unemployed registered in the city is no less than 25,000, but this figure shows a drop of 500 as compared with the previous week, and is 10,000 less than the return of a year ago.

The Lighter Steel Branches.

The makers of crucible steel are gradually taking a more cheerful view of the situation. A slight upward movement has been noticeable for the greater part of the year, and, although it has made slow progress, the state of things now is much better than it was twelve months ago. One thing which has particularly tended to hold this trade back has been the existence of surplus war stocks, parcels of which have been offered from time to time. There was such a large quantity of these stocks that the demand for new material was naturally seriously affected. Now, however, we seem to have got to the end of the surplus. It is reported that the whole of the remaining stocks have been sold to a customer abroad. The lot includes high-speed and carbon tool steel and shear steel, and some of the first-named cost the Government at least 1s. 6d. per pound. The file, tool and other finished light trades show little expansion. A good many orders are being booked, but they are mostly of small dimensions. In one or two cases, file firms are well employed.

Iron and Steel Production.

The production of steel in the Sheffield district during September amounted to 83,000 tons, as compared with 94,000 tons in August and 71,000 tons in September of last year. Of the total, 40,000 tons consisted of basic, 34,000 tons of acid, and 4000 tons of acid Bessemer. The total of castings was 5000 tons. The Lincolnshire district, with an output of 48,000 tons, all basic, showed an increase of 10,000 tons on August, and of 12,000 tons on September of last year. The production of pig iron in Lincolnshire during September amounted to 61,000 tons, of which 47,600 tons were basic, compared with 61,400 tons in August, and 29,000 tons in September of last year.

Good Cutlery Orders.

There is some improvement in the cutlery trade, and the demand for stainless knives keeps up to large proportions; but many firms declare that prices are so severely cut that there is no profit to be made. Australia and New Zealand continue to send forward substantial orders, but shipments to other overseas markets are poor, and very unsatisfactory in comparison with the trade of pre-war days. The Christmas season business is on a good scale, but there are signs of its falling off. Although there are still large stocks of German pen and pocket cutlery, scissors and razors in this country, the demand for Sheffield articles of these kinds is improving, and there is a good sale for safety razor blades. During the week a large order has been booked for the cutlery and plate equipment of an important steamship line running between New York and Australia. The order is valued at some thousands of pounds, and will take several months to complete. Another good order booked during the week is from France and is for cutlery for hotel and restaurant use. This case is particularly interesting, as the deciding factor in the placing of the order was the high quality of Sheffield goods.

The Plating Trade.

There is little inquiry for expensive goods, and the hollow-ware branches are very quiet, apart from a few good orders for hotel plate. There is, however, a very good demand for goods of cheaper quality, particularly for unplated spoons and forks, of which tons are being sent away every week. Spoons and forks made of stain-resisting metals are continually increasing in popularity, but they are taking the place of ordinary nickel silver rather than of electro-plated ware. For cheap cases of tea and fancy spoons, tea knives, &c., very large orders are being executed. An interesting event in connection with the silver trade during the week has been the dedication of a memorial to Thomas Boulsover, who invented the old Sheffield process of silver plating in 1742. The Sheffield master silversmiths subscribed about £900 for the erection of two screens in St. Paul's Church—Boulsover having been a parishioner of St. Paul's and being buried in the churchyard—and the memorial was dedicated by the Bishop of Sheffield on November 9th.

The New Master Cutler.

Mr. James Neill, the new Master Cutler, on Saturday night gave a dinner to the staff and employees of his firm, James Neill and Co., Limited, Composite Steel Works. There were about 200 guests. As I have pointed out before, Mr. Neill was not brought up to the steel trade. He remarked in his speech on Saturday that when he married he decided to go into the steel business, and he did so without any experience and without a single customer. All that he took home for a long time was very little more than what was now termed a labourer's wages. It had been stated, he said, that when he commenced making steel and iron ingots he used to push them round on a handcart to the different works, trying to sell them. That was not quite true. He certainly took them round on a handcart, but he did not push it. A feature of the gathering was the presentation to the Master Cutler by the staff and employees of an illuminated address commemorative of his year of office.

Colliery Progress.

Maltby Main Colliery, where the disastrous explosion occurred on July 28th, is now working well again. It had to be closed entirely after the explosion, and the east district, where the gob fires are, is still closed, but work has been resumed on the west side, and as much coal is now being drawn from it as ever. The south part of the pit, which was shut down in the early part of the war, owing to lack of labour, is to be reopened shortly. At Harworth, preparations are being made to meet the sewerage and sewage disposal needs of the large community which will soon grow up around the new colliery. Although the present population is only about 1200, an increase to 10,000 is expected to take place in a short time.

Lincoln Waterway Improvements.

The scheme propounded by Sir William Tritton for the improvement of bridges and waterways at Lincoln has been explained to the Lincoln Commissioners of Sewers by the Town Clerk. From his statement, some additional particulars of the project are to be gathered. He said that it was proposed to improve three important bridges in the city—at Brayford Head, the High Bridge, and Melville-street—and also the waterway by removing the present lock at Stamp End and placing another lock at Brayford Head and a wide fixed bridge in place of the present swing bridge there. It was also proposed to dig out the Witham to a depth of 3ft. 6in. between Brayford Head and Stamp End. So far as the cost of the scheme was concerned, no reliable estimate could be given. It might be anything from £50,000 to £100,000. The proposed lock would be 80ft. by 20ft., in which the level of the water could be lowered about 7ft. in order to permit the passage of the boats. Before the Corporation can proceed with the scheme, it is necessary to get the sympathy and assistance of the navigation and drainage authorities, of the London and North-Eastern Railway Company, the Lincoln Court of Sewers, the West Drainage Board and the Witham Commissioners at Boston. The Commissioners of Sewers, having heard the statement of the Town Clerk, decided to consider the scheme at their next meeting.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade and the Political Situation.

IN Northern trade circles there appears to be nothing but disappointment over the prospect of another General Election, and its consequent disturbance of the commerce of the country. This great industrial area is just turning the corner of what has been the worst period of trade depression ever experienced, and it is feared that the advent of a General Election might have the effect of stifling to a serious extent the progressive movement which has been observable in trade circles for some weeks past. There is, however, some satisfaction in the knowledge that it will soon be over.

Cleveland Iron Trade.

There has been a good deal of nervousness on the Cleveland pig iron market this week, consequent upon the disturbed political situation, and business has been somewhat quieter. The interruption is not serious, but buyers have not been operating with the same amount of confidence. Still, the general trade situation is fairly satisfactory. Industry is more active, pig iron consumption is increasing, and next week it is intended to start two more Cleveland blast-furnaces. Clearly there is a market for the additional output, and it is expected that still more furnaces will be lighted up in the near future. The export demand does not show much improvement, but home needs continue to expand, and it is to meet additional home requirements that more furnaces are being started. Prices are steady, No. 1 Cleveland foundry iron being 107s. 6d., No. 3 G.M.B. 100s., No. 4 foundry 99s., and No. 4 forge 98s.

Hematite Pig Iron.

Now that the steel works are becoming more active, the demand for East Coast hematite pig iron is becoming more insistent, and it is reported that some fairly large orders have been placed recently. Some makers are asking and realising 100s. 6d. per ton for mixed numbers, but it is still possible to obtain supplies at 100s. No. 1 is quoted at 101s.

Iron-making Materials.

The demand for foreign ore is still extremely quiet, and recent sales of best Rubio having been in the neighbourhood of 22s. 6d. per ton, that figure must be regarded as the c.i.f. market price. Coke prices are weaker. Some of the best makes still command 38s. per ton delivered at the works, but others are being sold down to 36s. 6d. per ton.

Manufactured Iron and Steel.

The manufactured iron and steel trade continues to improve in all directions. A steady buying movement has set in, and although the works are operating well below capacity, there is a continuous improvement in the state of trade and prospects. Quotations, though unchanged, show a marked upward tendency.

The Coal Trade.

The Northern coal trade displays a remarkably steady tone in some directions, but in others there is weakness observable, chiefly confined to Durham classes. The arrival of tonnage just now, however, is very heavy, and may serve to improve the colliery position in some instances, and may be reflected again in a steadying tendency where there has been a recent relapse. The general inquiry from the Scandinavian, Belgian and French importers is on the whole fairly extensive, but does not result in much forward business being placed. This is to be accounted for by the high prices at present ruling and to the hope that supplies may be obtained later on at lower rates. There are in circulation reports about the negotiations which have been in progress in London for some time in connection with the placing of "sterling credits" for the purchase of English coals for Germany. The latest indications are that there has been a hitch in the proceedings. One report is that the "Stinnes Group" is not a party to the transaction, which, of course, would be likely to neutralise the value of the arrangement, if it could be concluded. Another report is to the effect that at best the negotiations are likely to be prolonged by reason of the extreme difficulty in obtaining the large number of German signatures which will be necessary if the arrangements are to be satisfactory and workable. Northumberland steam coals of every kind are very steady. Only limited quantities are held by merchants. The collieries are well sold, and are rigidly adhering to their quotations, and in odd cases indicating even higher figures. Second steams are as steady as bests, while smalls are easily disposed of at current figures. The Durham gas coal market is not in any sense stable or uniform. The forward position is said to be satisfactory, but for prompt there is considerable variation and fluctuation in prices. Coke continues to be a most disappointing market. Patent oven foundry makes are weak and plentifully offered at a discount. Gas coke is steady.

Immediate Start with New Copper Works.

It is understood that the Rio Tinto Company, Limited, is to make an immediate start with the erection of its new works at Cargo Fleet, Middlesbrough. Plans have been put in hand, and preliminary work will begin next week. The project comprises the erection of plant for copper smelting and the disposal of by-products, in addition to new wharves and facilities for ships to bring the raw material direct to the site at Cargo Fleet.

SCOTLAND.

(From our own Correspondent.)

Better Conditions.

THE situation in the steel, iron and allied trades continues to improve. The forward movement is slow, certainly, but a change to even slightly brisker conditions is welcomed and seems to promise well for the near future. The placing of some railway orders has, no doubt, had a good effect, and the hopeful feeling regarding the shipyard situation has also had some influence. Continental competition is evidently not so keenly felt at present, and producers are more inclined to the belief that better prices can now be obtained for home materials. At any rate, the indication in the various markets points that way, even although quotations, in most cases, are still nominally unchanged.

Reopening of Clyde Shipyard.

It is stated that Yarrow's yard at Scotstoun is to be reopened. At the end of the year 1921, Messrs. Yarrow closed down this yard owing to repeated strikes, reduction of output, and demarcation disputes in various industries throughout the country, which had caused the cost of shipbuilding to rise to excessive heights, and also made it almost impossible to guarantee dates of delivery. In August last year, Messrs. Yarrow reopened their boiler department. The company has now received an order for a large shallow-draught river steamer of the Yarrow type, which will be specially designed for carrying oil fuel in bulk. This vessel is for the Anglo-Saxon Petroleum Company for service on the Yangtze Kiang, between Ichang and Chungking, where navigation is difficult owing to rapids and whirlpools.

Better Inquiry for Pig Iron.

Consumers of pig iron have been more active during the past week, showing more disposition to purchase ahead even at the firmer prices asked. Transactions have not been very large, and with stocks in fair bulk and outputs equal to all demands, a further rise in price is not immediately anticipated.

Copper Advanced.

Manufactured copper has been advanced by £3 per ton, making the price £95 per ton basis for strong.

Steel.

The steel market is a shade brighter, but until the boilermakers are again at work business is bound to be somewhat one-sided. Specifications for plates remain scarce, and sections, though a trifle busier, have plenty of room for improvement. Light sheets maintain their activity, especially for export, but the all-round home demand is unsatisfactory. Galvanised corrugated sheets are extremely firm.

Bar Iron Improving.

A better home demand has been experienced for bar iron during the past week, and an increasing turnover is anticipated. The market is firmer in tendency, although prices are still nominally unchanged. Re-rolled steel bars are busier and firmer, the price being somewhere about £9 5s. per ton.

Foundry Works Dispute.

Sir William Mackenzie, K.C., arbitrator in the dispute between the National Light Castings Ironfounders' Federation and the Central Ironmoulders' Federation and the National Union of Foundry Workers, has issued his award as follows:—That the weekly rate payable to daysmen moulders by the members of No. 1 district (Falkirk and East of Scotland) of the National Light Castings Ironfounders' Federation should be the same as that paid to daysmen moulders by the members of No. 2 district (Glasgow and West of Scotland) of the Federation, namely, 52s. 7½d., plus 11s. 6d. per week war bonus, this award to operate from the beginning of the first full-pay period following November 1st, 1923.

Coal: Firm, but Less Active.

The Scotch coal trade has not altered much during the past week. Owners are holding out for full current prices for round fuel for future delivery, but buyers are not prepared to pay such prices unless for small quantities for immediate consumption. Washed nuts are plentiful and still incline to weaken. The foregoing remarks are applicable to all districts. The loading stations have been very busy for a week or two fulfilling old orders, but slackness is now evident. Total shipments for the past week amounted to 286,429 tons, against 331,305 tons in the preceding week, and 300,521 tons in the same week last year. The home market is only moderately busy apart from a heavy demand for household fuel.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

Coal trade conditions have followed very much on the lines expected, and there has been no special feature in business during the past week. The inquiry continues on modest lines practically from all quarters, and consequently the tone is certainly on the quiet side. Unfortunately, in view of the approaching discussions regarding the claims of the miners for a revision of the agreement, work in this coalfield has been very irregular. This, of course, does not improve the prospect of compromise, and so far as this district is concerned, there is already some talk by leaders of the extremist type that if the central body does not achieve what is desired, then South Wales should consider the question of taking separate action. They point out that unless they effect important amendments in the present agreement, then a crisis in the industry is inevitable. While, however, the new demand for coals is on a limited scale, and there appears to be no prospect of any of the German requirements coming to this district, the position of collieries is slightly better than it was last week, and may improve still further, though not to such an extent as to make shipments really brisk. Undoubtedly, the docks are doing very good work in the loading line, and vessels are being turned round very quickly, but there is no real pressure, as is evident by the fact that there are idle loading berths. Tonnage is, however, coming along in larger volume, and what is of some importance is the fact that the improvement in outward rates of freight, consequent upon the urgent demand by collieries for prompt boats to keep them working, has brought out, and will continue to bring out, a certain amount of tonnage which has been laid up on account of unremunerative rates. Exporting firms which recently took on c.i.f. business based on the low rates of freight which were ruling a fortnight or so ago are not feeling very cheerful, seeing that rates for the Mediterranean have advanced to quite a sufficient extent to turn their business from a profit into a loss. The improvement in rates will, however, be very welcome to shipowners, and it may be that values will rule in the future on a slightly higher level, inasmuch as tonnage is now getting more dispersed, and trading to the Black Sea is absorbing a good deal of tonnage which formerly, owing to there being no freights homeward from that direction, had to confine running to the Mediterranean only.

Trimmers' and Tippers' Demands.

Both the trimmers and tippers in this district have their grievances, and a joint conference of these workmen has been called. In the case of the tippers, they have called on their headquarters to move in the matter of bringing the third shift to a termination. The six months' trial period for which the third shift was to operate comes to an end early next month, and, of course, the irregular working which has been inevitable of late, owing to the scarcity of tonnage, has stiffened the men in their antagonism to the continuance of the third shift after the trial period. At the same time, it has been demonstrated over and over again that the working of this extra shift has proved highly beneficial to the trade, and steamers have been able to save a considerable amount of time, as they have been turned round much more quickly. In the case of the trimmers they have raised the question of higher payment for the shipment of washed duff coals, and instances have occurred of the men refusing to work on vessels loading these coals. The trimmers' grievance on this matter is not a new one, and though the percentage of these coals may not be considered a large one in relation to the other coal shipped, it is essential that there should be a satisfactory arrangement come to, as the demand for washed coal is an increasing one, and it is more than ever essential that coals should be washed and sent forward in as clean a condition as possible in order to meet competition.

Non-unionism.

It looked last week-end very much as if there might be serious trouble in the Rhondda district on the non-unionist question. Notices in accordance with official instructions had been served in that area in order to bring pressure upon a very small percentage of workmen who were in arrear with their contributions. These notices expired on Saturday last, but still the leaders had given instructions that in all lodges where there was not a clean sheet the notices were to be postponed for a fortnight. The miners of the Tylerstown and Pontygwaith pits of D. Davis and Sons, numbering 4000, came out on strike on Saturday, but decided to resume work on the Monday, while a settlement was also brought about at Locket's Merthyr Colliery at Mardy, where a number of the workmen stopped work because three men were in arrears.

Steel and Tin-plate Trade Items.

The cheering news is forthcoming that the Ebbw Vale Steel, Iron and Coal Company has secured an order for 6000 tons of rails for the construction of railways in India. Delivery has to be made within the next three months, and the rails will, of course, be shipped at Newport. It is calculated that this contract will mean work for about 3000 men. As the bar millmen had come to the decision to cease work at twelve noon instead of at two o'clock on Saturdays, the South Wales steel employers have made a counter move by stopping the mills at 6 a.m. on Saturdays, thus causing a great number of the day men to lose a shift. The action which was decided upon by the bar millmen was without the sanction of their union.

Current Business.

Operations on the steam coal market have been quiet, and the inquiry from abroad is far from being active. At the same time, tonnage which was fixed some time ago is coming along better, and as the position of individual collieries has improved slightly, owners are naturally stiffening somewhat their ideas regarding prices. It cannot be said, however, that values have appreciably moved up, but there are not so many weak spots in the market. It is reported that one of the French State Railways has purchased about 100,000 tons of large steam coals and smalls, for delivery over next year, on the basis of 26s. 6d. and 18s. 6d. f.o.b. respectively, but apart from this there has been very little buying for forward delivery. This is only natural, seeing that prices recently for prompt loading have been below what collieries were prepared to accept over next year, and this, of course, induced buyers to go on the hand-to-mouth principle. At the present time, best Admiralty large coals are on the basis of 27s. 6d. to 28s., and second qualities 26s. 6d. to 27s., while smalls, which are somewhat scarcer on account of the recent numerous stoppages at the collieries, range from about 15s. to 18s. 6d. for the best. In the anthracite section the tone is quiet, though duff coals are firm. Large-sized coals are not quite so good.

Swansea Metal Exchange.

The tin-plate market is firm and prices are better. The home and foreign demand has improved, and already works are booking up orders for the first three months of next year. Makers are not upset by the fact that notices have been served by the enginemen and firemen, and it is interesting to find that already the men at some works have withdrawn their notices. It is reported that a large oil plate order for delivery up to March next is likely to be placed shortly.

SCHOLARSHIPS IN ENGINEERING.

The Council of the British Electrical and Allied Manufacturers' Association (Incorporated) has recently granted the following scholarships, tenable for one year, each of the value of £100 and the payment of college fees:—

In Electrical and Mechanical Engineering.—John Douglas Cockcroft, tenable at Cambridge University; Mr. Cockcroft received his education at Todmorden Secondary School and Manchester University. Arthur Bernard Everest, tenable at Birmingham University; Mr. Everest received his education at Rugby School.

In Electrical Engineering.—George Knowling Franklin, tenable at Manchester College of Technology; Mr. Franklin received his education at Wellington College, Berks. George Sail Campbell Lucas, tenable at City and Guilds (Engineering) College, South Kensington; Mr. Lucas received his education at Rugby Technical School. Richard Cyril Matthews, tenable at City and Guilds (Engineering) College, South Kensington; Mr. Matthews received his education at Rugby Technical School. Henry Lotham McBroom, tenable at the Royal Technical College, Glasgow; Mr. McBroom received his education at Airdrie Higher Grade School and the Royal Technical College, Glasgow. John Leonard Orme, tenable at Birmingham University; Mr. Orme received his education at Birmingham Technical College. Cecil William Richards, tenable at City and Guilds (Engineering) College, South Kensington; Mr. Richards received his education at Rugby Technical School. Rowland Wright, tenable at the City and Guilds (Engineering) College, South Kensington; Mr. Wright received his education at Rugby Technical School.

In Mechanical Engineering.—John William Davison, tenable at Manchester College of Technology; Mr. Davison received his education at Harris Institute, Preston. Matthew Geddes, tenable at Glasgow University; Mr. Geddes received his education at the Royal Technical College, Glasgow. Isaac Herdman Hedley, tenable at Durham University; Mr. Hedley received his education at the Technical School, Newcastle-on-Tyne. Hubert Christopher Lack, tenable at Manchester College of Technology; Mr. Lack received his education at the Grammar School, Loughborough, and Loughborough College. Albert Layland, tenable at Manchester College of Technology; Mr. Layland received his education at the College. Bruce Sydney Pelton, tenable at London University; Mr. Pelton received his education at Erith Technical Institute.

LAUNCHES AND TRIAL TRIPS.

Maloja twin-screw passenger vessel; built by Harland and Wolff, Limited; to the order of the Peninsular and Oriental Steamship Company, Limited; dimensions, 625ft. by 73ft. 3in. by 44ft.; 20,800 gross tonnage. Engines, twin-screw, driven by two sets of inverted direct-acting quadruple expansion, pressure 215 lb.; constructed by the builders; trial trip, October 25th.

Corduff, steel screw steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of Cory Collieries, Limited; dimensions, 284ft. by 42ft. by 21ft. 9¼in.; 3280 tons deadweight. Engines, direct-acting, surface condensing, pressure 180 lb.; constructed by G. T. Grey and Co., Limited; launch, November 6th.

CONTRACTS.

J. Dampney and Co., Limited, inform us their "Miraculum" graphite paint has been specified for the overhead equipment of track and other structural steel work in connection with the South African Railway electrification scheme, and also by the Great Indian Peninsular Railway.

Meldrums Limited, of Timperley, Manchester, received during the month of October orders for forced draught furnaces for sixteen boilers and stokers for five boilers, the orders coming from a brewery, three laundries, a railway group, an electric light company, a steel works, a gas company, an india-rubber company, and a County Council. During the same period the firm also received orders for seven destructors, a disinfector and a gas washer scrubber to deal with 22 million cubic feet per twenty-four hours.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Thos. Marshall and Sons, of Armley-road, Leeds, desire us to say that Mr. Harold Way has taken up with them the position of sales manager.

We are asked to say that all future communications regarding the crankless engine embodying Mr. Michell's principle should be addressed to the London director of the Crankless Engines (Australia) Pty., Limited, Mr. R. P. Wilson, whose address is Central House, Kingsway, W.C. 2.

Royal Institution.—The ninety-eighth course of Juvenile Lectures at the Royal Institution, to be delivered this Christmas by Sir William Bragg, F.R.S., is entitled "Concerning the Nature of Things," and will deal with I., The Atoms of which Things are Made; II., The Nature of Gases; III., The Nature of Liquids; IV., V. and VI., The Nature of Crystals (*a*) Diamond, (*b*) Ice and Snow, (*c*) Metals. The first lecture will be given on Thursday, December 27th, 1923, and the succeeding ones on December 29th, 1923, and January 1st, 3rd, 5th and 8th, 1924.

Catalogues for Turkey.—The Commercial Secretary at Constantinople reports that he has now arranged a representative selection of catalogues of British firms in his offices at the British Consular residence at Galata, Constantinople. In order, however, that British catalogues may be available for traders in the interior, arrangements have been made, by courtesy of the Imperial Ottoman Bank, for British catalogues to be displayed at its agencies in the following towns in the interior:—Broussa, Konia, Trebizond, Adana, Mersina, Adrianople, Smyrna, Eskishehir, Angora, Samsoon. British firms desiring their catalogues to be displayed at any or all of these towns are invited to send sufficient copies to the Imperial Ottoman Bank, Limited, Trade Development Department, 26, Throgmorton-street, London, E.C. 2, which will arrange for their re-transmission to Turkey, subsequently submitting a claim for the cost of postage.

Allen-Liversidge, Limited, Staff Dinner.—The staff dinner of Allen-Liversidge, Limited, was held at the Trocadero Restaurant on Friday evening last under the chairmanship of Mr. C. Storey Gilman. Among the large company which attended it were, in addition to numerous members of the staff of both sexes, a goodly sprinkling of guests. After the health of "The King" had been proposed by the chairman, and drunk with musical honours, the toast of the evening—that of "The Staff"—was given by one of the firm's managing directors, Mr. F. G. Allen, who, in an excellent and eloquent speech, dwelt on the cordial relations which existed between staff and directorate, and to which was, he said, very largely due the success which the company had achieved. Mr. W. C. Freeman, replying on behalf of himself and his colleagues, paid a hearty tribute to the solicitude for the welfare of its employees which was always evinced by the directorate. The toast of "The Guests," given by the chairman, was replied to in a witty speech by Major A. Cooper Key, while the health of the Chairman was proposed by Colonel J. Sterling, D.S.O., M.C. The speeches were interspersed with items of a well-arranged musical programme, and the evening was a success in every way.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 5 0	—
No. 1 Foundry	5 5 0	—
No 3 Foundry	5 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 1 6	5 1 6
Cleveland—		
No. 1	5 7 6	5 7 6
Silicious Iron	5 7 6	5 7 6
No. 3 G.M.B.	5 0 0	5 0 0
No. 4 Foundry	4 19 0	4 19 0
No. 4 Forge	4 18 0	4 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge*	—	—
„ „ Foundry	4 13 6 to 5 0 0	
(3) Northampton—		
Foundry No. 3	4 12 6	—
„ Forge	4 2 6	—
(3) Derbyshire—		
No. 3 Foundry	4 12 6 to 4 15 0	
Forge	4 4 6 to 4 7 6	
(3) Lincolnshire—		
No. 3 Foundry	4 13 0	—
No. 4 Forge	4 10 0	—
Basic	4 15 0	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	5 15 0 (*a*) / 5 17 6 (*b*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best „	13 0 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 12 6 to 10 15 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¼in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 5 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	12 10 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 15 0†	—
Light „	9 5 0 to 9 15 0†	
Billets	8 10 0 to 11 10 0†	
Manchester—		
Bars (Round)	10 10 0 to 10 15 0	
„ (others)	10 5 0 to 10 7 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 5 0 to 10 10 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 10 0	—
Hoops	12 10 0	—
Soft Wire Rods	11 10 0	—
Midlands—		
Small Rolled Bars	10 0 0 to 10 10 0	
Billets and Sheet-bars	8 2 6 to 8 5 0	
Gas Tube Strip	10 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	19 0 0 to 19 5 0	
Angles	9 12 6 to 9 15 0	
Joists	9 12 6 to 9 15 0	
Tees	10 12 6 to 10 15 0	
Bridge and Tank Plates	10 0 0 to 10 5 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½ to 26/-
Block Tin (cash)	221 0 0
„ (three months)	221 0 0
Copper (cash)	63 5 0
„ (three months)	63 15 0
Spanish Lead (cash)	31 2 6
„ (three months)	28 5 0
Spelter (cash)	33 10 0
„ (three months)	33 12 6
Manchester—	
Copper, Best Selected Ingots	67 10 0
„ Electrolytic	69 0 0
„ Strong Sheets	95 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0
„ Condenser	0 1 2½
Lead, English	33 0 0
„ Foreign	31 10 0

FERRO ALLOYS.

(All prices now nominal.

	Per Ton.	Per Unit
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£22 0 0	9/-
„ 8 p.c. to 10 p.c. „	£21 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£65 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 6/- per unit	
„ Vanadium	19/- per lb.	
„ Molybdenum	9/- per lb.	
„ Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£130	
Cobalt	11/6 per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	23/-
„ „ Ell	24/-
„ „ Splint	24/6 to 26/6
„ „ Trebles	22/9
„ „ Doubles	22/-
„ „ Singles	19/6
Ayrshire—	
(f.o.b. Ports)—Steam	23/-
„ „ Splint	24/6
„ „ Trebles	22/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	21/6 to 23/6
Screened Navigation	28/-
Trebles	24/- to 25/-
Doubles	23/-
Singles	20/6
Lothians—	
(f.o.b. Leith)—Best Steam	23/6
Secondary Steam	22/-
Trebles	24/6
Doubles	22/6
Singles	20/6

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	29/-
Household	46/8 to 57/6
Coke	43/6
Northumberland—	
Best Steams	25/- to 26/6
Second Steams	22/6 to 23/-
Steam Smalls	15/- to 16/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/-
Second	22/6 to 23/6
Household	25/- to 28/-
Foundry Coke	50/- to 52/6
Sheffield	Inland.
Best Hand-picked Branch	31/6 to 32/6 —
Barnsley Best Silkstone	27/6 to 29/- —
Derbyshire Best Brights	27/- to 29/- —
„ „ House	23/- to 24/- —
„ „ Large Nuts	21/- to 22/6 —
„ „ Small „	15/- to 16/- —
Yorkshire Hards	21/- to 23/- —
Derbyshire „	20/- to 22/- —
Rough Slacks	11/6 to 13/6 —
Nutty „	10/- to 12/- —
Smalls	5/- to 8/- —
Blast-furnace Coke (Inland)	30/- to 31/-
„ „ (Export)	f.o.b. 35/- to 36/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/6 to 28/-
Second „ „	26/6 to 27/-
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	26/6 to 27/-
Western Valley „	25/- to 26/-
Best Eastern Valley Large	24/- to 25/-
Ordinary „ „	23/- to 24/-
Best Steam Smalls	17/6 to 18/6
Ordinary „	16/- to 17/-
Washed Nuts	27/6 to 30/-
No. 3 Rhondda Large	28/- to 29/-
„ „ Smalls	24/- to 25/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/6 to 19/6
„ „ Smalls	16/- to 17/-
Coke (export)	42/6 to 50/-
Patent Fuel	29/- to 32/-
Pitwood (ex ship)	28/- to 28/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	40/- to 45/-
Seconds	34/- to 36/-
Red Vein	32/- to 33/-
Machine-made Cobbles	53/6 to 55/-
Nuts	52/6 to 55/-
Beans	45/- to 46/-
Peas	26/- to 27/-
Breaker Duff	12/9 to 13/-
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	24/- to 25/-
Seconds	23/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b

* Quotations extremely high and nominal. † Latest quotations available. (*a*) Delivered Sheffield or Glasgow. (*b*) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Miners' Wages.

THE dispute over the claim by the miners in the Nord and the Pas de Calais for an advance in wages threatened last week to provoke another of those serious perturbations to industry which have been unpleasantly frequent during the past three or four years. Having given way so often, the coalowners were determined to resist any further augmentation of wages, which are already four times as much as they were in 1913, while the average individual production is about 20 per cent. less. The men base their claim on the high cost of living, and it is futile to hope to convince them that the living cost increases automatically with the wages, and that unless they co-operate to stop this inflation, there is no reason why it should end at all. Under ordinary circumstances it is probable that the dispute would have involved a strike, with the prospect of dear coal at the beginning of the winter, and the Government has therefore been making strong efforts to settle a dispute which, if followed by a strike at the present moment, would have regrettable consequences. The coalowners have listened to the Government appeal, and have consented to advance wages by 2.75f. and 3f. a day, according to the category of hands. The advance will take effect for three months. The acceptance of the men's claims in the Nord has naturally stiffened the attitude of the Miners' Union, which announces its intention of demanding an increase of wages in the other coal centres, as well as an extension of the pension, insurance and other advantages. This pressure of the Union upon the Government at a moment when it is unable to risk a conflict with labour is causing a good deal of uneasiness, for if the Government were to give way, the situation would be an extremely precarious one for industry. Already the advanced wages in the Nord has been accompanied by an increase in the cost of coal, and there is no reason why coal prices should not continue to inflate with the additional charges which an acceptance of the Union programme would place upon coalowners as well as upon the country's financial burdens. The wages problem is a serious factor in the increasing production costs that are placing manufacturers in a difficult position. So far, the workers have succeeded in securing advantages beyond what they would appear to be legitimately entitled to, and the result is an encouragement to agitate for more—a state of things that tends automatically to a continued increase in costs.

A Commercial Policy.

The Government has been urged for a long while past to declare a commercial policy which will remove the elements of uncertainty that seem to compromise the future of foreign trade. So far as may be judged from the returns of trade with other countries, the situation would appear to be satisfactory, but on analysing those returns, it is seen that by far the most important purchaser of French goods is Great Britain, which also heads the list of countries importing into France. While, however, the bulk of the British purchases consists of manufactured goods on which labour has been expended, the British imports into this country are mainly coal and coke and raw material. This state of things is, of course, the result of the exchange rate, which practically excludes goods that can be manufactured here, and the fuel and raw material imports make up largely for the deficient supplies from Germany. Whether France will again become a valuable market for British goods depends upon the future course of events, and especially upon the commercial policy which the Government may adopt. There has been, so far, an entire lack of a defined commercial programme. The idea of imposing separate arrangements on a reciprocity basis has only been carried out to a limited extent, and the results have not always come up to expectation. The new fiscal policy is also in abeyance. Meanwhile, the commercial community is more and more insistent in its demands for a policy which will facilitate foreign exchanges, and it is all the more anxious to settle upon a definite programme because of the fear that the protectionist movement in Britain may partially close the British Empire to products and goods from this country. The idea of developing home and colonial resources to the extent of rendering France self-supporting has been so strongly impressed upon the public generally that it has become a dogma; but the commercial and industrial classes know that it is impossible to carry out that policy in its entirety, and the home production has increased so enormously with the retrocession of Alsace-Lorraine that the industries cannot exist without an export trade. If this trade is to be encouraged and developed, it can only be done by the Government elaborating a policy that will offer certain advantages to other countries.

Rail Motors.

The experiments that have been carried out during the past year with motor vehicles on local railway lines on which the traffic is not sufficient to allow of steam locomotives paying their way, have so far given satisfactory results that numbers of new rail motors are being ordered. Messrs. Schneider et Cie. have received from the State Railways orders to transform ten more coaches for motor propulsion similar to the one in service between Mortaigne and Sainte-Gauburge, of which a description has been published in THE ENGINEER. Other types of rail motors are running experimentally in different parts of the country, and in view of the results obtained, it is probable that the proposal to employ petrol motors on local lines that are now being run at a loss will be entirely realised in the early future.

Electric Train Lighting.

The instructions issued two years ago to the railway companies to equip the whole of the passenger coaches for electric lighting fixed January 1st next as the limit of time allotted for the work. An official inquiry reveals that 22,000 coaches are now equipped, and that 10,000 more have to be transformed to ensure the complete suppression of gas lighting, while another 12,000, which are approaching the end of their period of active service, will be allowed to use oil lamps until they are withdrawn.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

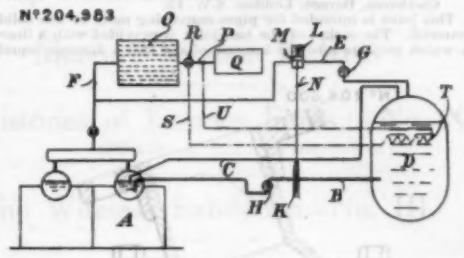
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

204,983. December 28th, 1922.—IMPROVEMENTS IN AND CONNECTED WITH STEAM GENERATING INSTALLATIONS, *Babcock and Wilcox, Limited, of Oriel House, Farringdon-street, London, E.C.* 4.

This invention relates to a steam generating installation with heat and superheat storage units, and the object is to render the superheating as uniform as possible and to utilise to advantage the superfluous superheat. The steam boiler A is connected by pipes B and C to a steam and hot water storage vessel D, the so-called heat storage unit. The discharge pipe E from the upper part of the vessel D leads to the main steam pipe F coming from the boiler. In the pipe lines E and B there are non-return valves G and H. By means of a slide valve arrangement K and a spring, piston and piston-rod arrangement connected therewith the passage of boiler water into the vessel D can be regulated in accordance with the pressure in the pipe E. The main

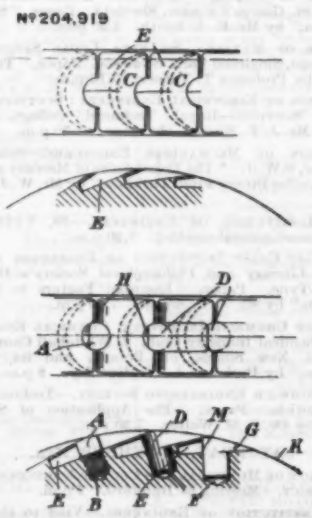


pipe F leads to a superheat storage unit O, which may be of the same form as the ordinary regenerator used in heating aeriform fluids, comprising a chamber containing chequer brickwork spaced for the passage of steam. From the unit O a pipe P leads to the steam consumer Q. In the pipe P, between the superheat storage unit O and the steam consumer, there is a three-way cock R, through which the steam from the superheat storage unit O can be partly or wholly led to a pipe S which leads to one end of a cooling coil T immersed in the water in the vessel D. The other end of this coil is connected by means of a pipe U to a point in the pipe P nearer the consumer Q than the cock R. By adjustment of the cock R therefore any desired proportion of the superheated steam can be by-passed through the attemperator T and so brought to the correct temperature before entering the steam consumer Q. The superfluous superheat removed from the superheated steam serves to increase the temperature of the contents of the storage unit D.—*October 11th*, 1923.

TURBINE MACHINERY.

204,919. October 19th, 1922.—IMPROVEMENTS IN AND CONNECTED WITH STEAM TURBINES, The English Electric Company, Limited, of Queen's House, 28, Kingsway, London, W.C. 2, and John Picton Chittenden, of 90, Hillmorton-road, Rugby.

This invention relates to the construction of elastic fluid turbines of the type in which the blades are formed by machining out a series of semi-circular pockets in the rim of the running wheel. By using a cylindrical pin such as A, screwed into a tapped hole B, to fill recesses C a wall is provided to close the central part of the outer side of pockets E, thus forming a channel through which motive fluid may flow. Clearly this construction

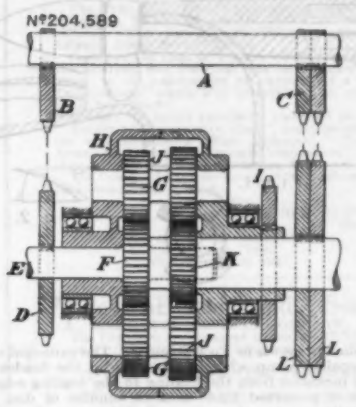


does not form a continuous cylindrical surface around the wheel. For this purpose L-shaped pins D are used. These members have a curved surface or surfaces M to form an enclosing wall for the corresponding pocket, and to fit into and close the recess in the outer wall, whilst one limb of each pin fits into a recess F of the wheel. On the side remote from the recess they have a tapering limb G extending over the exterior of the outer wall of the adjacent pocket. A flat H on the top of the pins serves to continue the outer surface of the pocket wall over the recess C, but when plain pins are used the remainder of the top surface is caused to follow the contour of the wheel. In the case of the L-shaped pins the tip of each tapered portion fits on and covers the flat on the end of the adjacent pin, and the remainder of the surface of the end of each pin and the outer edge of each limb is curved to an arc of a circle, so that the integral of all the small arcs forms the continuous cylindrical surface K. Besides serving to form arcs of this cylindrical surface, the tapering limbs G assist the guidance of motive fluid into pockets E. When L-shaped pins are used it becomes necessary by electrical welding or by other suitable means to secure them in position.—*October 11th*, 1923.

TRANSMISSION OF POWER.

204,589. November 21st, 1922.—VARIABLE SPEED GEAR, H. W. Pearn, 8, Leagate-road, Heaton Moor, Manchester.

In this gear, the driving, or engine shaft A has thereon two sprocket wheels B C, one of which, B, is connected by a chain to a sprocket wheel D fast upon the shaft E, which carries the sun wheel F of an epicyclic gear. The sun wheel F meshes with planet pinions G upon a planet carrier H, to which is secured a sprocket pinion I from which the variable speed is obtained.

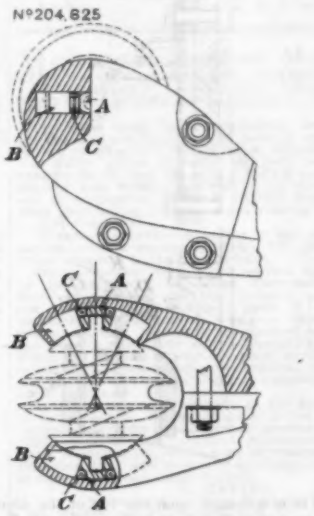


The planet pinions G are formed with other planet pinions J which mesh with a second sun pinion K driven through a variable speed chain-driven sprocket L from the second sprocket wheel C on the engine shaft A. The variable speed chain drive for the sun pinion K comprises driving and driven sprocket wheels made up from a number of sectors which can be moved away from, or towards, the sprocket wheel axes to vary the gear ratio.—*October 4th*, 1923.

TRAMWAYS AND RAILWAYS.

204,625. November 9th, 1922.—IMPROVEMENTS IN TROLLEY HEADS FOR USE IN ELECTRIC TRACTION SYSTEMS, Ernest Edward Mathers, 15, Laughton-road, Hexthorpe, Doncaster.

This invention relates to a trolley head containing horizontal moving journals, for use with electric tramcars, &c. The horizontal moving journals A A, in which the pulley spindles revolve, slide inside the horizontal guides B B. These guides B B

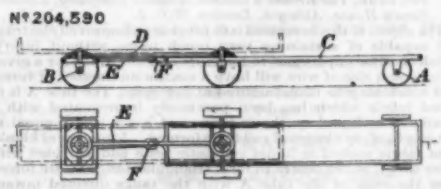


permit the moving journals A A to rotate horizontally backward and forward, approximately 27 deg., on either side of the neutral position. This rotary movement of the journals A A is facilitated by the small steel dome rollers C C, inserted at the extreme corners of the movable journals A A.—*October 4th*, 1923.

MOTOR CARS AND ROAD TRAFFIC.

204,590. November 24th, 1922.—ARTICULATED VEHICLES, R. Garrett and Sons, Limited, Leiston, Suffolk, and M. L. Luiggi, 115, Victoria-street, London, S.W. 1.

The object of this invention is to ensure that the rear wheels of a six-wheeled vehicle shall track with the intermediate wheels. In the drawing the front steering wheels are shown at A. The



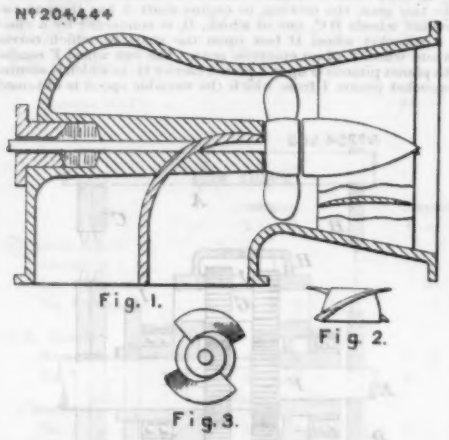
rear wheels B are tied to the main frame C by means of the pivoted draw-bar D. Fixed on the frame of the rear wheels there is a lever E, which engages with a projection F on the rear of the main frame. It will be seen that as the main frame is steered round by the front wheels, the rear wheels will be turned

in the opposite direction, so that they track with the others.—*October 4th*, 1923.

PUMPING AND BLOWING MACHINERY.

204,444. July 17th, 1922.—Propeller Pumps, *The Metropolitan-Vickers Electrical Company, Limited*, 4, *Central-buildings, Westminster.*

This specification goes, at great length, into the theory of design for the type of pump shown in the drawing, and includes a number of diagrams and curves. The general form of

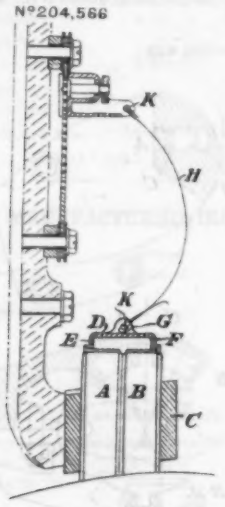


the impeller is shown in Figs. 2 and 3. The principal claim is for a propeller pump wherein the pitch of the blades of the propeller increases from the leading to the trailing edges, and the ratio of projected blade area to annulus or disc area is substantially equal to the reciprocal of the ratio of pitch ratios of the trailing with respect to the leading edges of the blades.—*October 4th*, 1923.

DYNAMOS AND MOTORS.

204,566. November 3rd, 1922.—Improvements in and relating to Dynamo-electric Machines, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, London, W.C. 2, and Frank Percy Whitaker, of 237, Clifton-road, Rugby.

This invention relates to an improved method of applying pressure to dynamo brushes, circumferentially divided into sections. The object of this invention is to apply pressure to brushes, divided circumferentially of the commutator into two sections, in such a manner as to ensure that each section keeps in contact with the commutator. The two sections A and B of the brush are placed close together in a holder C. A rocking

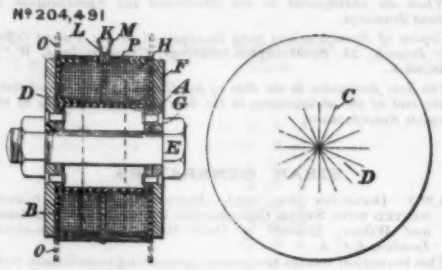


member D is mounted upon the top of the divided brush so that it bears at each end, as by projections E F, for example, upon the respective sections A and B. Pressure is applied to the rocking member D at a point G, which is central with respect to the two sections A and B, so that normally the applied pressure is substantially equally distributed between the two sections of the brush while permitting independent movement of each section. A flexed plate spring H is pivoted at the upper end K to a projection on the holder, and is provided at its lower end with a loop which bears at point G on the rocking member D, a pin K passing through the loop and carried by ears on the rocking member acting as a guide for the loop.—*October 4th*, 1923.

MISCELLANEOUS.

204,491. August 30th, 1922.—Improvements in and relating to Electrical Coils and Methods of Manufacturing the same, *The British Thomson-Houston Company, Limited, Crown House, Aldwych, London, W.C. 2.*

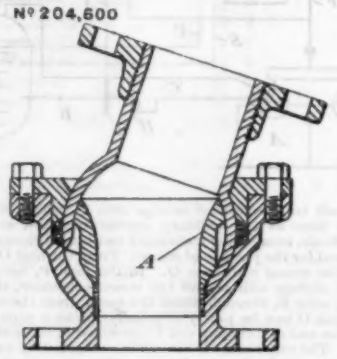
The object of this invention is to provide an improved electrical coil capable of sustaining very rough usage without injury, which shall be impervious to moisture and oil, which for a given volume and size of wire will have a maximum number of turns, and which may be manufactured at low cost. The tube A is of cured fabric which has been previously impregnated with a powdered or liquid synthetic resin, and has a length equal to the length of the electrical coil to be formed. A number of blanks B of fabric soaked in liquid synthetic resin and provided with cross slits C at the centre to form triangular tangs D, are forced over the ends of the tube A with the tangs directed inward and they are pasted to hold them in position. The metal support comprises an ordinary bolt E with two steel washers or end plates F having riveted to their inner surfaces concentric washers G of a size sufficient to enter the bore of the tube A and hold it central relative to the end plates F. The metal support, with its limp spool, is now ready for mounting in a lathe or winding machine, after which it is tightly wound with insulated conductor wire H. Enamelled or coated wire, or any form of insulated wire may be used. Preferably the length of the coil is divided by a central transverse insulating barrier K, forming, in effect, two coils joined at their inner ends across the barrier and with the outer ends or terminals L and M of the two coils extending outwardly on opposite sides of the periphery of the



barrier. The diameter of the blanks B will be made somewhat larger than the diameter of the final coil, so that there will be a narrow zone O at the periphery of each blank for flanging over the outer layer of wire where they are pressed downsmoothly and firmly united by windings of tape P soaked with liquid synthetic resin and encasing the periphery of the coil.—*October 4th*, 1923.

204,600. December 7th, 1922.—Ball and Socket Pipe Joints, Gwynnes Engineering Company, Limited, Crisp-road, Hammersmith, London, W.6, and S. Roberts, 120, Castlenau, Barnes, London, S.W. 13.

This joint is intended for pipes conveying more or less solid material. The socket of the ball joint is provided with a liner A which projects into the interior of the ball a distance equal



to or greater than one-half the diameter of the ball, the liner being of such a diameter, externally, near where it passes into the socket as to allow of the necessary angular movement of the ball in the socket and the end near but beyond the middle of the ball has a part-spherical contour to fit against the interior of the ball.—*October 4th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Metals: Sheffield Local Section.—The University, St. George's-square, Sheffield. Paper, "Substitutes for Platinum," by Mr. E. A. Smith. 7.30 p.m.

Institute of Metals: Swansea Local Section.—University College, Singleton Park, Swansea. Paper, "The Density of Alloys," by Professor T. Turner. 7.15 p.m.

Institution of Electrical Engineers: Scottish Centre, Students' Section.—Royal Technical College, Glasgow. Address by Mr. J. F. Nielsen, chairman. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. "The Possibilities of Mercury as a Working Substance for Binary Fluid Turbines," by Mr. W. J. Kearton. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society's Hall, Newcastle-upon-Tyne. Paper, "Essential Factors in Ship Propeller Design," by Mr. A. F. Ainslie. 7.30 p.m.

Society of Chemical Industry: Chemical Engineering Group.—Chemical Industry Club, 2, Whitehall Court, S.W. 1. Paper: "A New Source of Potash, and its Industrial Exploitation," by Professor J. W. Hinchley. 8 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper, "The Application of Science to Industry," by Dr. C. M. Walter. 7.30 p.m.

SATURDAY, NOVEMBER 17TH.

Institution of Municipal and County Engineers: Yorkshire District.—Meeting at Bradford. 2 p.m.

Junior Institution of Engineers.—Visit to the carriage and repair depôt of the Underground Railways at Acton. 2 p.m.

Keighley Association of Engineers.—Visit to the works of J. Parkinson and Son, Shipley. Train leaves Keighley 2 p.m.

MONDAY, NOVEMBER 19TH.

Bradford Engineering Society.—Technical College, Bradford. "The Control of Combustion in Boiler Plants," by Mr. R. B. Davis. 7.30 p.m.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Paper, "The Misuse of the Internal Combustion Engine and Suggestions for its More Efficient Application," by Mr. L. Murphy. 7.30 p.m.

Institution of Automobile Engineers: Birmingham Centre.—Queen's Hotel, Birmingham. Dinner. 7.30 p.m.

Institution of Civil Engineers: Newcastle-on-Tyne Association.—Neville Hall, Newcastle-on-Tyne. Presidential address by Mr. D. Balfour. 7.30 p.m.

Institution of Mechanical Engineers: Graduates' Section.—Storey's Gate, Westminster, S.W. 1. Special exhibition of industrial kinematograph films. 7 p.m.

Royal Institute of British Architects.—The Large Hall of the Royal Society of Medicine, at No. 1, Wimpole-street, Cavendish-square. Lecture, "The Rebuilding of Ypres," by Mr. G. Topham Forrest, F.R.I.B.A. Illustrated by lantern slides. 8 p.m.

TUESDAY, NOVEMBER 20TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. Paper, "The Founding of Admiralty Gun-metal and Allied Alloys," by Mr. F. W. Rowe. 7.15 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, E. 1. "Reversing Systems of Large Marine Oil Engines," by Miss V. Holmes, B.Sc. 6.30 p.m.

Institution of Automobile Engineers.—Broadgate Café, Coventry. Joint meeting of the Birmingham and Coventry graduates. Debate, "Features of the Motor Show (1) Braking Systems and Steering, and (2) Number of Cylinders." 7.45 p.m.

Institution of Civil Engineers.—Great George-street, S.W. 1. Papers:—"The Effect of Groyning on Some Parts of the English Coast," by Mr. R. F. Grantham; "The Tides from an Engineer's Standpoint," by Mr. E. W. Hollingworth. 6 p.m.

Manchester Geological and Mining Society.—Queen's Chambers, 5, John Dalton-street, Manchester. Ordinary meeting. 4 p.m.

WEDNESDAY, NOVEMBER 21ST.

Association of Consulting Engineers.—St. Stephen's Club, Westminster, S.W. 1. Annual dinner. 7 for 7.30 p.m.

Association of Drop Forgers and Stampers.—Assembly Hall, Chamber of Commerce, Birmingham. Lecture, "Drop Forging Practice: No. III., Clipping and Clipping Tools," by Dr. Leslie Aitchison. 7.30 p.m.

Institution of Civil Engineers: Students' Section.—Great George-street, S.W. 1. Address by Mr. H. H. Mardon. 6 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section meeting. "Periodic Trigger Reception," by Messrs. E. V. Appleton and F. S. Thompson; "A Dynamic Model of a Valve and Oscillating Circuit," by Mr. R. C. Clinker. 6 p.m.

Institution of Production Engineers.—The Engineers' Club, Coventry-street, W. 1. Paper, "The Use of Charts in Engineering," by Mr. A. W. Swan. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders: Graduate Section.—Neville Hall, Newcastle-on-Tyne. "The Mechanism of Gaseous Ignition," by Dr. W. M. Thornton. 7 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, S.W. General meeting. 5 p.m.

Institution of Automobile Engineers: Wolverhampton Centre.—Star and Garter Hotel, Wolverhampton. Discussion, "Repairs and Breakdowns." 7.30 p.m.

THURSDAY, NOVEMBER 22ND.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Joint meeting with the Société des Ingénieurs Civils de France, British Section. Paper, "The Electrification of the Midi Railway," by Monsieur A. Bachellery. 6 p.m.

Institution of Locomotive Engineers.—The Engineers' Club, Coventry-street, W. 1. "Locomotive Shed Lay-out," by Mr. F. W. Attock. 7 p.m.

THURSDAY TO THURSDAY, NOVEMBER 22ND TO 29TH.

Public Works, Roads and Transport Exhibition.—At the Royal Agricultural Hall, Islington, N. 1.

Institution of Automobile Engineers.—The College, Loughborough. Loughborough graduates' meeting. Paper, "Shock Absorbers," by Mr. Prior. 7 p.m.

FRIDAY, NOVEMBER 23RD.

Institution of Municipal and County Engineers: West Midland District.—Council House, Birmingham. Paper, "Municipal Engineering Education," by Mr. E. G. Timbrell. 5.30 p.m.

SATURDAY, NOVEMBER 24TH.

Institution of Automobile Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Informal meeting. Demonstration and discussion on "Ignition Systems." 6.30 p.m.

Institution of Automobile Engineers.—Visit of London graduates to the printing works of the *News of the World*, Bouverie-street, E.C. 4. 7 p.m.

WEDNESDAY, NOVEMBER 28TH.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Paper, "The Misuse of the Internal Combustion Engine and Suggestions for its More Efficient Application," by Mr. L. Murphy. 6.30 p.m.

THURSDAY, NOVEMBER 29TH.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Joint meeting with the Physical Society of London. Discussion, "Loud Speakers for Wireless and Other Purposes." 5.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Technical Arbitrations," by Mr. W. A. Tookey. 7.30 p.m.

Royal Aeronautical Society.—Royal Society of Arts, 18, John-street, Adelphi, W.C. 2. Paper, "The Development of High-speed Aircraft," by Major R. H. Mayo. 5.30 p.m.

FRIDAY, NOVEMBER 30TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. "Clyde Marine Oil Engines," by Professor A. L. Mellanby. 6 p.m.

THURSDAY, DECEMBER 6TH.

Newcomen Society.—Room 13, Caxton Hall, Westminster, S.W. 1. Annual general meeting. Paper, "The Dynamics of Leonardo da Vinci," by Mr. Ivor B. Hart. 5.15 p.m.

FRIDAY, DECEMBER 7TH.

Junior Institution of Engineers.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Inaugural meeting. Presidential address, "Marine Propulsion during Fifty Years," by Sir J. Fortescue Flannery. 7.30 p.m.